BULLETIN
OF THE
INTERNATIONAL RAILWAY CONGRESS
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[656]

Competition by roads, waterways and airways.

(*Continuation*) (1).

France, Italy, Algeria, British India, and French Indochina.

FRANCE

The note published below, for which thanks are due to the Management Committee of the French Main Line Railways, relates to the position and steps taken during the third quarter of 1934.

I. — Road competition.

A.– Statistics relating to such competition.

Passengers.

Length in kilom. *(in miles)* of road motor services regularly operated in France on the 30th September 1934 :

	Alsace-Lorraine.	*Est.*	*State.*	*Nord.*	*Paris-Orleans and Midi.*	*P. L. M.*
1. *Permanent services worked :*						
a) By the railways	None.	None.	None.	None.	None.	None.
b) By concession-holders on behalf of the railways . .	150 *(93.2)*	475 *295.1*	193 *(119.9)*	488 *(303.2)*	300 *(186.4)*	1 233 *(766.1)*
c) By other public undertakings	7 300 *(4 536)*	12 128 *(7 530)*	30 050 *(18 672)*	16 815 *(10 448)*	59 800 *(37 159)*	28 000 *(17 400)*
2. *Temporary services worked :*						
a) By the railways	None.	None.	None.	None.	None.	None.
b) By concession-holders on behalf of the railways . .	1 282 *(796.6)*	23 *(14.3)*	None.	93 *(57.7)*	6 980 *(4 337)*	None.

(1) Cf. *Bulletin of the Railway Congress Association*, June 1934 to May 1935.

Goods.

Number of lorries in circulation in France on the 30th September 1934 :

No new information has been received on this to modify the figures already supplied for 1933.

C. — Steps taken by the French Main Line Railways to fight road motor competition.

I. — Technical measures.

a) *Organisation of motor services.*

No new services could be introduced in view of the regulations imposed by the decree of the 19th April, 1934, on the co-ordination of rail and road transport, which stipulates in clause 5 that until the ministerial decrees sanctioning the proposals of the Co-ordination Committee are issued, no new public transport service can be started.

b) *Introduction of rail motor coaches.*

On the Nord System, the trains have been replaced by rail motor coaches with an additional service between Compiègne and Roye, and it has been found possible to introduce a new fast service between Tourcoing, Roubaix, Lille and Paris, and vice versa, thanks to the introduction of fast rail motor coach sets.

The State System has continued to develop the use of rail motor coaches, either to replace little used trains, or to increase the service, particularly to operate additional seasonal services, or to make new connections.

In addition, some of the existing rail motor coach services have been intensified in order to meet the favourable reception they have received from the public.

On the 1st July, the Paris-Lyons & Mediterranean introduced rail motor coach services on the following routes :

Frasne - Vallorbe, Frasne - Pontarlier, Pontarlier - Vallorbe, Laroche - Auxerre, Auxerre-Avallon, Laroche-Vermenton.

Moreover, a rail motor coach service was introduced on the 1st August between Lyons and Grenoble, and on the 1st September between Auxerre and Clamecy and between Gravant and Clamecy.

The Alsace-Lorraine Railways have also actively carried out their programme to extend the use of rail motor coaches in proportion as they can take delivery of the stock ordered for this purpose. The new rail motor coaches were put into service on six lines around Metz, and also on the same number of lines in the Strasbourg district.

c) *Increasing train speeds.*

When its shorter rakes of all-metal stock were put into service, the French Nord accelerated by about 35 % the speed of some sixteen week-day trains on different suburban lines.

d) *Introduction of through services.*

The use of the new rail motor coaches has made it possible to introduce new connections and to make appreciable savings in the journey time on certain runs, thanks to the greater speed of these units, thus offering passengers new travelling facilities.

e) *Organisation of parcels collecting services.*

In order to reduce the transit times

for parcels, steps have just been taken on the Alsace-Lorraine to increase the number of dispatches between the large transhipment centres, making use if need be of passenger or mail trains.

The Paris-Lyons & Mediterranean has organised collection services in some of the larger centres, which are run over a definite route advertised to the public by means of posters at the stations concerned.

f) *Transport in containers.*

The railways continue to develop the use of containers under the conditions quoted in the previous notes.

The Paris-Lyons & Mediterranean, in particular, has put fifteen new containers into service during the third quarter of 1934, and is carrying out trials in transporting mutton from Morocco in refrigerated containers.

g) *Door to door services.*

Development of cartage and lorry services :

During the third quarter of 1934, the cartage, lorry, and re-consignment services have been extended to 27 new places on the State, and 10 new places on the Paris-Orleans and Midi; a great proportion of the parcels traffic is handled by the railway in this way instead of being handed over to the road transport firms.

h) *Other measures.*

Depots have been set up at various places on the Paris-Orleans and Midi Railways, at which consignors can hand over post parcels or packages not exceeding 50 kgr. (110 lb.) in weight. The cartage services take these consignments to the station.

2. — Commercial measures.

a) *Introduction of special rates.*

b) *Granting of fixed prices.*

I. — PASSENGER RATES.

Among the chief measures taken during the third quarter of 1934 are the following :

Issue of cards entitling the holder to receive half-rate tickets between Paris and stations on the State system, within 100 km. (62 miles) of Paris (31st August 1934).

Extension of the delivery of « departemental » cards for joint State — Paris Orleans-Midi — Paris-Lyons & Mediterranean traffic (3rd August 1934).

Extension to all the railways of circular tickets the holders of which can select their own routes, the saving over the usual fare being the greater as the distance increases (31st August 1934).

Lower minimum distance for cheap fares to watering and health resorts (31st August 1934).

In the case of the International Union rates for issuing combined tickets, a reduction of 20 % for 1st-class fares, and 15 % for 2nd or 3rd-class, on the cost of the coupons for the French parts of the journey when the whole ticket for a circular or an outward and return journey covers a distance of not less that 1 000 km. (621 miles) (including the foreign parts of the journey).

II. — GOODS RATES.

As far as the goods services are concerned, mention may be made of :

— the change from the wagon-kilometre rate to maximum and minimum rates;

— the introduction of exceptional arrangements in favour of special wagons which can run on rail and road, as well as for wagons specially equipped to carry road motor lorries and trailers, empty or loaded;

— the granting of special reduced rates for consignments of crockery to the Paris district;

— various rates remodelled in favour of grouped consignments and various kinds of goods conveyed between different places.

c) *Issue of combined railway-and-road tickets. — Through registration of luggage.*

The Paris-Lyons & Mediterranean has developed its services making connection with road services. At all stations on this railway, combined tickets are issued to all the places served by road services.

At the beginning of the journey, passengers can book tickets to their final destination when the place they are going to is served by any of the railway's auxiliary services. They can also register their luggage for the whole journey and pay the whole of the amounts due for such transport at the beginning of the journey.

D. — Modifications in legislature likely to affect the relations between the railways and the road motor services.

A ministerial decree dated the 3rd August 1934, after consulting the professional organisations concerned, nominated the members of the Co-ordination Committee set up by the decree of the 19th April 1934.

II. — Competition from water transport services.

A. — Statistics relating to such competition.

General table showing the traffic for the 3rd quarter of 1934, and comparing it with the tonnage for the previous year.

Tonnage loaded during the first three months. Metric (*Engl.*) tons.		In comparison with 1933.	Tonnage loaded since the beginning of the year. Metric (*Engl.*) tons.		In comparison with 1933.
1934	1933	Decrease, %	1934	1933	Decrease, %
12 619 859 *(12 420 540)*	13 252 935 *(13 034 619)*	4.8	37 629 198 *(37 034 882)*	38 680 148 *(38 069 233)*	2.7

B. — Steps taken by the railways to meet water competition.

By means of special provisions (contract arrangements and in particular contract rates), the railway was able to retain traffic currents which were threatened by waterways.

Amongst such measures are :

— the granting of special rates for carrying soap, edible oils, and stearine to the Paris district;

— the introduction of contracts for mineral waters sent from Vichy and

Vittel to stations on the French Nord Railway, outside the Grande Ceinture, threatened by other forms of transport, and on the return of empty bottles.

The way such problems are to be looked at, however, has changed owing to the steps taken to co-ordinate railway and water transport (Cf. § C below) which led to agreements being made between the two methods of transport.

During the third quarter of 1934, two agreements of this kind were entered into by the parties concerned :

— an agreement between the navigation interests and the State Railways (18th July 1934) on the Lower Seine traffic (in the Havre-Paris direction only);

— an agreement between the navigation interests and the Paris-Lyons & Mediterranean Railway (26th July 1934) on the Rhône traffic.

These agreements are based on more or less similar lines : division of the traffic into a certain number of groups, giving each group a certain average tonnage or percentage of the traffic, based on the results of one or several years' working. The Paris-Lyons & Mediterranean agreement also includes a fine to be paid to the railway for any excess traffic carried by water, as well as a reciprocal agreement to revise the tonnage given to each group if important changes take place, and to investigate together all cases of new traffic.

C. — Modifications in legislature likely to affect the relations between the railways and waterways.

As a result of the decrees of the *31st March 1934,* modifying the general regulations on inland waters, of the *30th June 1934,* regulating the chartering of boats for inland navigation, and of the *15th May 1934* on the co-ordination of railway and water transport, already analysed in the two previous notes, the following points must be noted :

I. — The *decree of the 21st September 1934,* applying the above mentioned decree of the 15th May 1934, which regulates the public administration, deals with :

1. the composition, duties and functioning of the Central Co-ordination Committee and of the Regional Co-ordination Commissions; these latter, seven in number, are made up of representatives of the railway and navigation interests, under the presidency of a representative of the Minister of Public Works;

2. the transport of various kinds of goods for which, in pursuance of the above mentioned decree of the 15th May, a licence is already to be applied for; the decree of the 21st September gives precise details as to the extent, duration and conditions of such licences;

3. new boats; the decree forbids new boats to be put into service other than those replacing broken up stock, and boats of equal tonnage.

II. — The *decree of the 28th October 1934,* completed by the ministerial decree of the 29th October 1934 *(Official Journal* of the 30th October), which lays down the limits of jurisdiction of each of the seven Regional Commissions set up according to clause 3 of the decree of the 21st September 1934, and fixes, on the one hand the number of representatives to be nominated by water transport undertakings for each of the regional Commissions, and on the other, the list of professional organisations which are to take part in each district in nominating the representative of the navi-

gation interests for the corresponding Commission.

* * *

III. — Air competition.

A. — Statistics relating to the traffic carried by the main French airways.

1. Passengers carried during the third quarter of 1934 : 17 608.

2. Parcels, newspapers, excess luggage carried during the third quarter of 1934 : 339 123 kgr. (333.77 Engl. tons).

3. Mails: 56 464 kgr. (55.57 Engl. tons).

B. — Steps taken by the railways to meet this competition.

None.

C. — Attempts to achieve collaboration. (Combined air and rail services.)

None.

D. — Modifications in legislature likely to affect the relations between the railway and air transport services.

None.

* * *

The Management Committee of the French Main Line Railways adds the following information, though this relates to events of a later date than the quarter in question.

As far as the co-ordination of rail and road is concerned, the Co-ordination Committee has drawn up Public Administrative Regulations on the co-ordination of passenger transport; these Regulations were published in the *Official Journal* of the 26th February 1935.

As far as co-ordination between rail and water transport is concerned, the Central Committee and the Regional Commissions for co-ordination were set up during the last quarter of 1934 and are now at work.

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ITALY

Information supplied by the General Management, Commercial and Traffic Department, of the Italian State Railways.

The following measures were taken during the last quarter of 1934 in the case of passenger traffic.

On the 1st December 1934, at the beginning of the winter sports season, week-end and holiday tickets with a reduction of 50 % in the case of single passengers and 70 % in the case of groups of passengers were extended to all places within a radius of 250 km. (155 miles) of the departure station. At the same time the minimum number of passengers required in order to obtain the 70 % reduction was lowered from 15 to 5.

At the same date, a new tariff for luggage simplified the formalities, and granted a reduction of about 20 %.

Return tickets with a reduction of 20 % were extended to cover a distance of 250 km. (155 miles) instead of 100 km. (62 miles).

Passengers travelling in groups of a minimum of 20 who got a reduction of 30 %, receive reductions of 30, 40 and 50 % according as to whether the group is made up of 8 to 50, 51 to 100 or over 100 people.

The price of season tickets is reduced by 10 % and the issue of weekly season tickets and holiday tickets for employees, artisans, workmen, and daily workers has been extended to students at governmental and like schools, both grammar and higher.

A reduction of 30 % is granted to passengers and commercial travellers on the cost of the card which makes it possible for them to get half-price tickets.

A reduction of 50 % is granted to families travelling together in groups of at least 4 persons, including grandparents, and one servant when the family properly speaking (father, mother and children) already number four.

The age limit up to which children are carried free has been extended from 3 to 4 years, and that for half price transport from 7 to 10 years.

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ALGERIA

Joint management of the Algerian lines of the French State and those of the Paris-Lyons and Mediterranean Railways.

Measures taken by the Railway Companies : In the case of passenger traffic, the new rate (in sections) continued to be much appreciated, and the noticeable increase in the average number of tickets issued since it came into force has not fallen off in any way.

In the case of goods traffic, the grouped rates have been extended to other branches, especially in the Constantine Département.

Measures taken by the Public Authorities : The Co-ordination Committee for railway and road transport, provided for in the decree of the 7th August 1934, has been set up.

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BRITISH INDIA

The **Bengal Nagpur Railway** states that during the fourth quarter of 1934, in order to meet the loss of goods traffic due to competition from maritime transport, reduced port-to-port rates were granted for various services to Bombay and Calcutta. In addition to this, reduced rates were put into force on certain narrow-gauge sections of the railway, in order to recover traffic lost to the road services.

Bombay, Baroda & Central India Railway Company.

Measures taken by this Company : Introduction of third-class return tickets at one and a half the cost of a single ticket, on certain sections where motor competition is particularly serious.

* * *

FRENCH INDO-CHINA

Compagnie française des Chemins de fer de l'Indochine et du Yunnan.

Measures taken by the Company during the fourth quarter of 1934.

Passenger traffic. — Various rating measures were taken, reducing the rates in force : fixed prices over certain sections of the first zone on the Hai-Fong-Hanoi—Yen-Bay line; reduction in the kilometric rates for passengers of all classes in the first zone; increase in the amount of luggage allowed free for 4th-class passengers; return tickets at reduced rates issued in Tonquin to all classes of passengers during the Hanoi Fair and Christmas and New Year holidays.

Goods traffic. — The minimum weight of less than wagon load consignments and complete wagon loads for various native products has been lowered.

A new tariff scheme has been prepared, which includes door to door collection and delivery, except when the consignor states otherwise, in order to recover traffic at present lost to river and road transport firms.

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INTERNATIONAL RAILWAY CONGRESS ASSOCIATION.

INQUIRY INTO QUESTIONS OF IMMEDIATE INTEREST.

(Decision taken by the Permanent Commission at its Meeting held on July 29th, 1933.)

QUESTION I.

Rail motor cars from the point of view of their construction.

B. — Underframe and body. — Heating and ventilation. Auxiliary apparatus. — Fire protection.

REPORT

(Countries of the European Continent),

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In the first part of the present report (see Bulletin of the Railway Congress, *October 1934), we gave the chief features of rail motor coaches running on the railways of Continental Europe.*

The methods of constructing the bodies, their interior arrangement and their various fittings will be described in detail in the following chapters :

CHAPTER IX. — *Underframe and body.*

CHAPTER X. — *Arrangements.*

CHAPTER XI. — *Heating and ventilation.*

CHAPTER XII. — *Auxiliary apparatus.*

CHAPTER XIII. — *Fire protection.*

* * *

CHAPTER IX.

UNDERFRAME AND BODY.

I. — Metal underframe and wooden body.

Most of the railways only used this type of construction for their older railcars, which now only represent a small proportion of the stock (about 10 %). This method of construction is generally no longer considered for new constructions.

A few railways only recently directed their attention to all-metal construction. Thus, the Danish State Railways own 65 railcars with wooden bodies out of the 76 vehicles in service, and the Czechoslovak Railways have 338 railcars with wooden bodies out of 390 in service; the latter Administration, moreover, intends

to retain the wooden body for light rail-cars.

The Finnish State Railways use wood exclusively for body construction and are continuing this practice in the case of the 4 units now ordered, probably because of the extensive supplies of wood in that country.

The Piedmontese Tramway Company are following the same practice, and have never considered any other form of construction.

* * *

II. — All-metal underframe and body.

1. Resistance of the combined underframe-body unit to the stresses to which it is subjected.

The problem as regards the strength of the vehicle to resist the various forces involves an investigation of the following main points :

a) *Resistance to the usual service stresses.*

The combined underframe-and-body unit should resist, without any appreciable deformation, the bending stresses to which it is subjected by the vertical loads it carries (dead weight, passengers, luggage), the dynamic bending and torsional stresses due to these loads when the vehicle passes over the various inequalities in the track being naturally taken into account.

The strength to resist the vertical loads and the dynamic bending and torsional stresses resulting therefrom is checked empirically in ordinary service, but can be controlled more accurately and more scientifically in the Works, as for example in the following way :

The whole unit — frame and body — being assembled, is carried on supports in line with the actual bearing points of the vehicle in service, and loaded in a given way and subsequently unloaded, after the maximum deflection has been measured.

The same test, with one of the supports removed and the maximum deflection measured, supplies information on the resistance to torsion.

In no case should any permanent deformation be found when the load is removed.

Table I summarises the results of tests carried out on a number of French rail-cars.

b) *Resistance to exceptional stresses.*

In the case of collision, the whole unit should be able to absorb to the maximum possible extent the inertia forces of the moving masses without such deformation occurring as might hurt the passengers.

This can be obtained in two absolutely distinct ways : either by designing a rigid underframe providing the resistance factor of itself, or by designing a very rigid underframe-body unit forming a tubular girder.

— *Rigid underframe providing the resistance factor of itself.* — The body assembled with this frame is then simply a shelter to carry the passengers.

In this form of construction the body can, however, be rigidly connected to the underframe and take part in stiffening up the whole. It must then be sufficiently rigid not to get out of line through the frame moving in service.

The body can also be attached elastically to the underframe. In this case, it plays no part in strengthening the unit. The body of the BUGATTI railcar, in particular, is connected to the underframe in a special way, i. e. by means of spherical cups secured to the longitudinals on which rest the spherical pivots carrying the body, indiarubber being inserted in between (fig. 1).

The desire to lighten the body has even led in the case of the 24-seater Micheline to a design not having any

TABLE I.

Vehicle.	*Test.*	*Results.*
RENAULT. Design in which the body sides transmit the forces.	Uniform load of 34 t. (33.46 Engl. tons) representing : Weight of the body + 2.5 the useful load.	Maximum deflection 25 mm. (1 inch). No permanent set.
FRANCO-BELGE. (Tubular girder type).	Torsion of the body when supported at 3 points.	The 4th point dropped 6 mm. (1/4 inch). No permanent set.
COMPAGNIE GÉNÉRALE DE CONSTRUCTION. (Rigid frame and light body type).	Flexion, then torsion of the bar frame loaded uniformly and carried on 4 supports at the ends of the sole bars.	No permanent set.
	Same test after erecting body on the frame.	Much smaller elastic deformations.
8-wheeled CHARENTAISES. (tubular girder type, in aluminium).	1. Body supported at 8 points corresponding to the axles. Weight of the body + 2 times normal load (uniformly distributed).	At the centre the amplitude of the oscillations was ± 1 mm. (3/64 inch).
	20 men in the rail coach subjected the vehicle to a rhythmic bending movement.	No permanent set.
	2. Body carried on the two headstocks. Weight of the body + 1.5 normal load acting inside the supports.	Deflection at middle point 8 mm. (5/16 inch). No permanent set.
DECAUVILLE. (tubular girder type).	1) Body carried on its normal supports, and weight made up by 200 people inside the vehicle.	No deflection.
	2) Same arrangement, but the 200 men making most disorderly movements.	Deflection of a few millimetres in the case of rhythmic movements.

body properly speaking, the underframe and the body framing forming one unit assembled by riveting and welding, the body being formed by a covering in thin metal sheeting lined inside with imitation leather fastened to wood blocks secured to the body frame members.

This extra-light type of construction, due to the limited loads pneumatic tyres can carry, has however been abandonned in the case of the Micheline railcars with 36 and 56 seats, these having a rigid underframe with a high moment of inertia (fig. 2), the light body being bolted to it and treated wood being inserted between the two.

— *Tubular girder.* — With this modern design, the modern principles regarding all-metal passenger stock construction are applied; the strength neces-

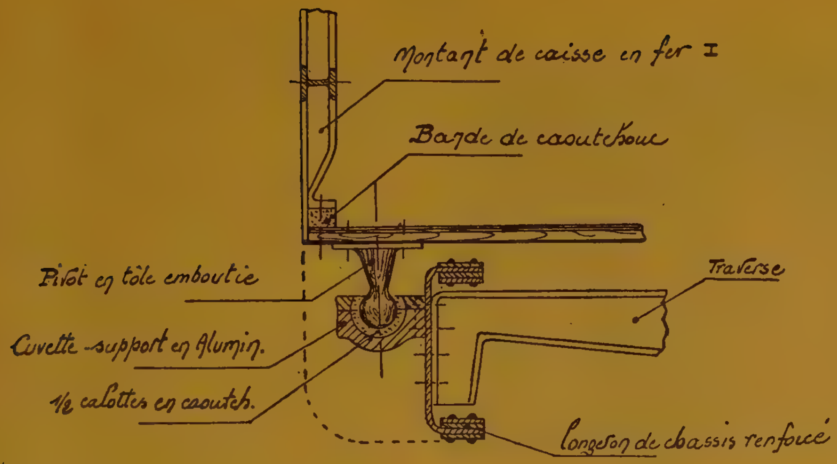


Fig. 1. — Bugatti railcar. Elastic connection between underframe and body.

Explanation of French terms:

Montant de caisse en fer I = Body pillar of rolled-steel I section. — Bande de caoutchouc = Strip of rubber. — Pivot en tôle emboutie = Pressed-steel pivot. — Cuvette-support en aluminium = Aluminium bearing cup. — 1/2 calotte en caoutchouc = Half cup-shaped rubber packing. — Traverse = Cross bearer. — Longeron de châssis renforcé = Strengthened sole bar.

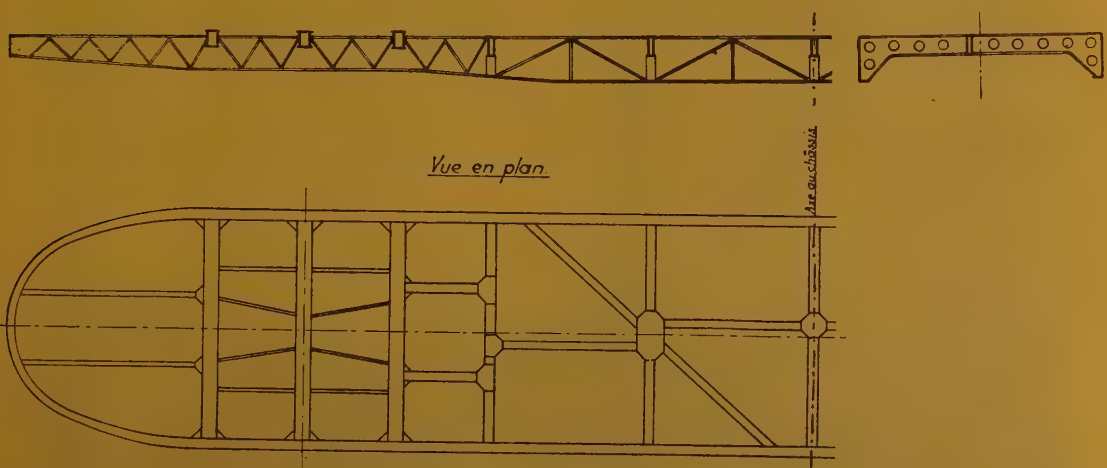


Fig. 2. — Underframe of the 36 and 56-seater Michelines.

Note: Coupe longitudinale = longitudinal section. — Coupe transversale = cross section. — Vue en plan = plan view. — Axe du châssis = centre line of underframe.

sary to withstand the shocks in case of collision is obtained by a very rigid underframe-body unit including very strong roof members firmly braced to the underframe by the two body sides. The whole unit, completed by relatively thick

metal sheeting (about 4 mm. = 5/32 inch), in all-metal railcars forms what is known as the « tubular girder ».

The description of « tubular girder » is, it must be pointed out, only partly true, as the ideal tube has never been built in railway stock, because in line with the bogies it is necessary to cut the tube.

However, the behaviour of this stock in case of collision has shown that the design was very satisfactory in the way of protecting the passengers, and this justifies the tendency of certain builders to follow this design.

This solution of the problem can, however, be obtained in practice in different ways :

— either, an endeavour is made to design a unit all the parts of which (side, roof and floor members) play their part in the general strength (e.g. the Franco-Belge rail motor trains);

— or, only the sides form the main resistance members, in which case they can simply be connected by the roof and the floor (e.g. the Renault railcars);

— or, contrariwise, the roof and the floor can be carefully designed from the point of view of strength and rigidity, the sides then simply acting as connections between these two parts (e.g. the Aciéries du Nord railcars);

It is necessary to point out, nonetheless, that railcars, by nature, must be lighter than up-to-date all-metal coaches, on account of the greater power they would otherwise need. These vehicles are therefore necessarily a little less rigid.

For instance, the outside sheeting, of steel or aluminium alloy, is so thin that in most cases it does not add materially to the strength (Maximum thickness of plates : 2 to 2.5 mm. = 5/64 to 3/32 inch).

As a rule, the ends are not specially strengthened. On the contrary, the builder expects, in some cases, the non-reinforced ends of the body to absorb, by deformation, the impact of the moving masses and so prevent any deformation of the underframe properly speaking, i.e. that part which carries the passenger compartment. For example, the Decauville railcars (French Nord), Ford (Sarre) (fig. 3), and Austro-Daimler (Austria) are built in such a way that on telescoping the engines themselves would absorb the greater part of the shock; the Czechoslovak 4-wheeled railcars are provided with strongly-built platforms on which passengers are not allowed to stand.

2. Precautions taken against telescoping or collisions.

When a train comes into collision, every coach making it up must absorb,

Fig. 3. — Ford railcar (Sarre).

besides the shock due to the obstacle met with, the impact from all the vehicles which are coupled up behind it; railway carriages must be specially designed to resist telescoping and it may be said that modern all-metal coaches meet the above requirements as far as possible.

The case of the railcar is rather different, as most often it is a vehicle intended to run by itself.

It is quite legitimate, therefore, independently of the question of weight, and consequently the traction cost of these vehicles, to accept the tubular girder type of lighter construction for such vehicles.

Figures 4 and 5 show a RENAULT railcar of rigid construction, after it had been run into and driven back by a locomotive, in a depot, against two wagons laden with rails, and then against a buffer. Only the ends have suffered, the passenger compartment being left intact.

Then too, a relatively light construction has the advantage of lower impact forces in case of collision, so that the damage done is not necessarily as serious as in the case of heavier stock.

Figure 6 shows a MICHELINE which had collided with a road motor car on the French State Railways.

This light Micheline, travelling at 92 km. (57 miles) an hour, ran into a road motor car moving over a level crossing. The motor car was hurled twenty yards away, and the railcar came off the rails, struck an obstacle and turned over, but only suffered relatively little damage from the collision and its after results. The passengers were only slightly bruised.

3. Buffing and draw gear.

Most builders have provided their railcars with buffing and draw gear.

a) *Buffing gear.*

A lighter type of railway buffer is usually resorted to.

Fig. 4. — A telescoped RENAULT railcar (France).

Fig. 5. — End of the RENAULT railcar, nearest the locomotive, after telescoping.

Certain French builders, however, to save weight in the case of railcars intended to run alone, have provided simple shock absorbers, of little weight, consisting of small buffers or merely bumper plates.

b) *Draw gear.*

These parts are sometimes of the ordinary screw coupling type, but lighter.

The builders, however, in view of the little use made of the couplings on ordinary rail motor cars, are satisfied in most cases with providing a simple eye bolt on each headstock. This can be used in connection with a special draw bar which fits on the ordinary draw hook, and is usually stowed in the guard's locker or under the body.

c) *Automatic couplings.*

Automatic couplings have found a certain number of applications on railcars. Thus, the *Scharfenberg* coupling is used

Fig. 6. — MICHELIN railcar (France), after coming into collision with a road motor car and a fixed obstacle.

in Germany, Austria, Holland and Hungary — and the *Willison* coupling in France.

To couple up a railcar with an ordinary vehicle in case of accident, however, requires a special device such as the lightened *Willison* transition coupling (fig. 7).

4. Description of some couplings used on multiple-unit railcars.

a) *Vehicles forming articulated units, permanently coupled together.*

We give hereafter a description of the couplings designed for the following railcars : S. O. M. U. A. (French State); Schnelltriebwagen (Reichsbahn); Double Renault (French State); La Brugeoise (Belgium); Dutch triplet sets; double Bugatti (P. L. M., France).

— *S. O. M. U. A. (fig. 8) — 2 articulated units on 3 axles.* — This six-wheeled rail motor car is formed of a four-wheeled motor unit and a trailer. The outer end of the latter is carried on a third pair of wheels, and the inner end on the underframe of the motor unit. For this purpose the underframe of the motor unit is fitted with a cast-steel hemispherical cup which, with the hemispherical pivot on the frame of the trailer, forms a central articulated coupling. A bolt keeps the two parts of the coupling permanently together.

The rolling movements of the trailer are prevented by two spring shock absorbers placed on both sides of the knuckle joint. Each of the trailer sole bars rests on the piston head of one of these shock absorbers, friction blocks being inserted, which allows of easy curve negotiation.

The trailer is either pulled or pushed, according to the direction in which the

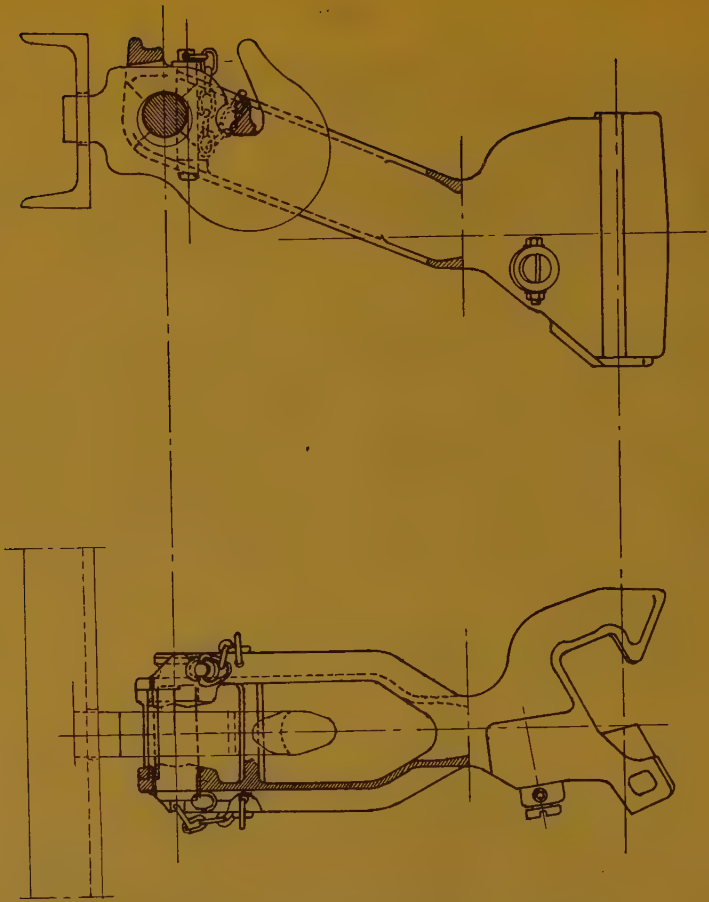


Fig. 7. — WILLISON transition coupling.

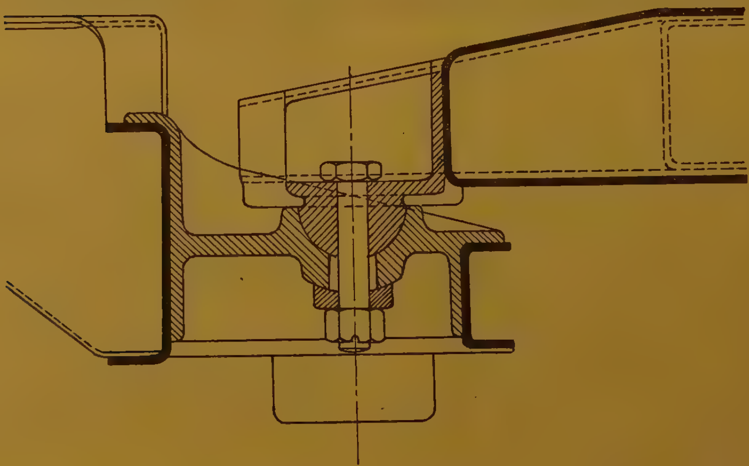


Fig. 8. — Coupling between the two units of the S. O. M. U. A. railcar.

vehicle is running, the resulting effort being transmitted by the articulated coupling itself.

— *Schnelltriebwagen, Double Renault twin car, La Brugeoise — 2 articulated units carried on 3 bogies (fig. 9).*

The underframe of each body carries at its inner end a spherical pin; the pin of one of the bodies fits in a spherical cup secured to the bogie and that of the second frame fits in a cup provided in the top of the first one.

The lateral stability of the two bodies is obtained by two semi-spherical buffers with large rubbing surfaces, fitted with double shock-absorber springs.

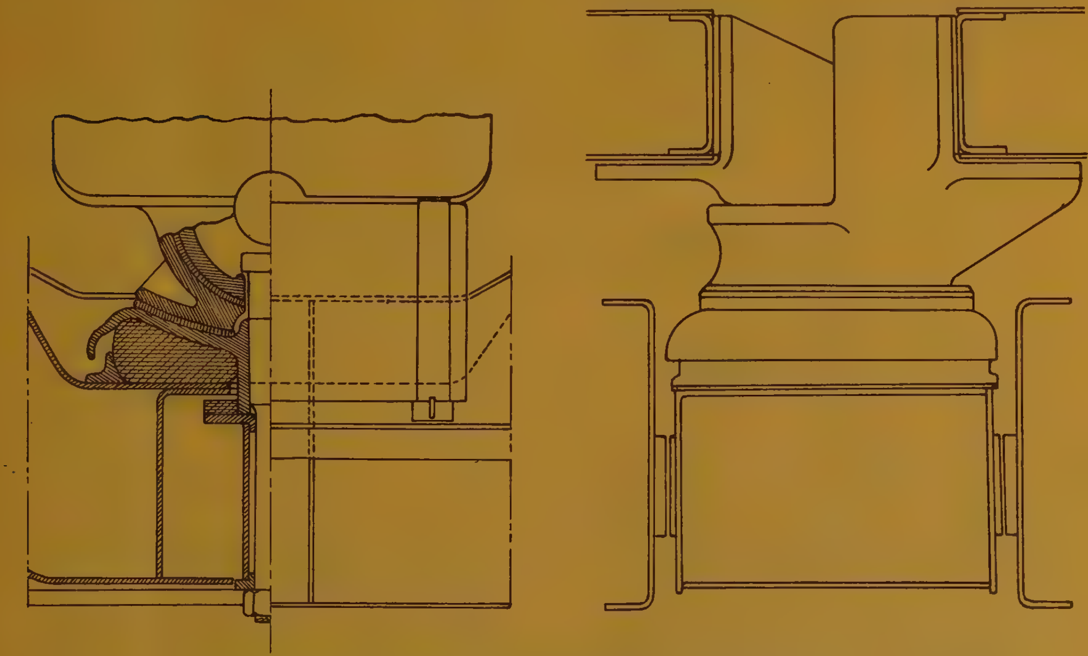


Fig. 9. — Double spherical bearing on which the bodies are carried on the middle bogie (SCHNELLTRIEBWAGEN, RENAULT twin, and LA BRUGEOISE).

— *Triplet cars of the Netherlands Railways — 3 articulated units on 4 bogies.* — Each intermediate bogie includes two separate supports close to each other, on both sides of the centre pair of wheels, on the longitudinal centre line of the vehicle. The adjacent end of the two bodies carried by the bogie is articulated on the nearest centre support.

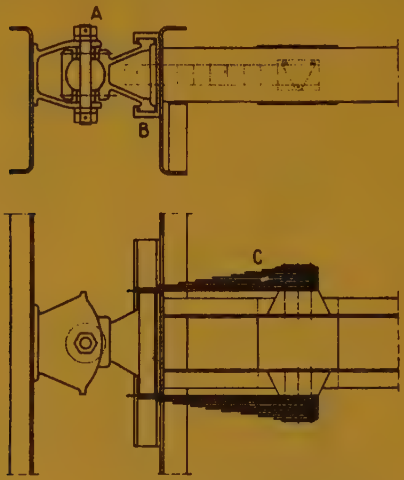
— *Bugatti twins — 2 units carried on 4 bogies (fig. 10).* — The underframes of the two bodies are connected by an articulation with knuckle pin and guide centered by two laminated springs.

b) *Railcars with can be worked either as a single unit or coupled to a trailer.* — There are only a relatively small number of railcars of that kind.

A description will be given of a coupling specially designed for the Bugatti railcars with trailers, which are now on trial on the French State Railways, and

of the coupling used on the Franco-Belge railcars in use on the Nord (France).

— *Bugatti.* — This is a « tramway » type of coupling; it is not automatic, and provides a combined buffing and draw gear.



A = Pin with spherical knuckle.
B = Slide.
C = Centering spring.

Fig. 10. — Spherical coupling between the two units of the BUGATTI railcar (France : Paris-Lyons-Mediterranean).

So far the running tests appear to be satisfactory. It must be added that, by using a special pole, the man coupling up the units can guide the draw bar into position without getting in between the vehicle and its trailer.

Franco-Belge. — As each part of the vehicle is independent as regards running, the only problem to be solved was that of the coupling, which, in this case, is a Willison central coupler, completed by 2 non-conjugated buffers.

One of the buffers has been partly lined with ferodo to brake the relative movements of the two adjacent bodies when passing over bad spots in the track, without interfering in any way with curve negotiation, ferodo being applied only at the centre of the buffer.

III. — Materials used and methods of construction.

1. General.

So far most builders have preferred ordinary steel to high-tensile steels. The latter have appeared on the market at a relatively recent date, and may be said to be still in the trial period in connection with railway rolling stock.

Properly so called rustless steels have not been used in Europe, with one exception; the Societa italiana per le Strade ferrata de la Mediterraneo uses a rustless steel assembled by the *Shotweld* process of the Budd Mfg. Co.

As a rule, the use of aluminium and its alloys has been limited to body fittings as castings, and especially for inside or outside lining sheeting, either bent, curved or pressed. The ENTREPRISES INDUSTRIELLES CHARENTAISES, in France, however, have built the whole of the underframe and body framing in duralumin rolled sections and aluminium sheet.

In certain cases, the use of certain materials is not possible or prohibited for other than technical reasons.

The GANZ Works in Hungary, for example, have had to give up the use of light alloys owing to importation difficulties.

As already mentioned, the Finnish State Railways probably use wood exclusively in body building, owing to the abundance of this material in that country.

2. Materials in current use.

a) *Steels.*

Ordinary carbon steels.

These steels, the usual qualities of which are semi-hard to mild, are used in all ordinary commercial forms : rolled sections, plates or pressings. Their cheap price and the well known methods of using them, have led many builders to prefer them for the main members.

In France, there is a definite tendency to use semi-hard open-hearth steel very carefully manufactured.

Special high-tensile steels.

Table II gives the main characteristics of the special steels most used and their principal applications.

Colum 5 gives, for two of the steels in question, a new characteristic known as the « dynamic elastic limit », from which it is possible to ascertain the resistance of the metal to alternated stresses at high frequency : the figures given have been obtained by means of a recent special machine, built by Messrs. SCHENCK, of Darmstadt, on test plates cut from the steel being tested.

b) *Light alloys.*

The light metals used are all aluminium alloys :

Aluminium :

Specific gravity : 2.6.

Characteristic of the metal :

Tensile strength = 11 kgr./mm² (7.0 Engl. tons per sq. inch). — Elongation = 40 %. — Elastic limit = 5 kgr./mm² (3.17 Engl. tons per sq. inch).

Pure aluminium is never used in parts subject to stress, but is most often used for the interior lining, ceiling, counter floor, the petticoat covering the running gear, and sometimes the roof itself.

Duralumin :

Characteristics of the metal :

Treated and aged.

Tensile strength = 38/42 kgr./mm² (24.12/26.67 Engl. tons per sq. inch). — Elongation = 16 to 24 %. — Elastic limit = 25 to 30 kgr./mm² (15.87 to 19.05 Engl. tons per sq. inch).

Duralumin is the light alloy most commonly used. It is used for all linings which, whilst not increasing the weight of the vehicle, are likely to undergo shocks, or wear, such as floors in luggage compartments, or the driver's compartments of railcars. For the same reasons, many builders have prefered to use aluminium for the outside body panelling or the roof.

The rail motor coaches built in France by the ENTREPRISES INDUSTRIELLES CHARENTAISES, mentioned above, consist of (cf. fig. 11) an underframe and a body built entirely of duralumin for the parts subject to stress or wear, with aluminium sheeting for non stressed parts of the vehicle.

Another interesting application of duralumin has been in the 24-seater Michelines.

Other alloys.

Other light alloys of various compositions are available on the market. Their characteristics and their prices enable them as a rule to be classed between duralumin and aluminium.

The wide use of aluminium and its alloys other than in the frame enables 2 to 3 tons to be saved on a rail motor coach about 20 m. (66 feet) long.

c) *Non-metallic materials.*

With the exception of wood of which the body is wholly or partly made, the majority of non-metallic materials used are linings to insulate the vehicles or make them silent, and they are dealt with in a special chapter. Other materials are used to furnish or decorate the interior of the rail motor coaches.

3. Design and method of making the various parts.

Cast parts are rarely used except as interior fittings (luggage-racks, door handles, etc.).

However, an example of the use of a cast part as an essential element of the structure is seen in the railcars built by the ACIÉRIES DU NORD, in France, with

TABLE II.

SPECIAL STEELS USED IN THE CONSTRUCTION OF RAILCAR UNDERFRAMES AND BODIES.

Class of steel. (1)	Tensile strength. Kgr/mm² (*Engl. tons per sq. inch*) (2)	Elongation. % (3)	Elastic limit. Kgr/mm² (*Engl. tons per sq. inch*) (4)	Dynamic elastic limit. Alternated bending. Kgr/mm² (*Engl. tons per sq. inch*) (5)	Used for (6)	Parts assembled by (7)	Types of railcar. (8)
Chrome-nickel steel	50/55 (*31.7/34.9*)	24	38/40 (*24.1/25.4*)	30 (*19.1*)	Body bolsters. Bogie sole bars and bolsters.	Electric welding and riveting.	FRANCO-BELGE. (French Nord).
Chrome-molybdenum steel . .	75 (*47.6*)	13	58 (*36.8*)	...	Frame and body throughout. (Outside sheeting up to bottom of side lights.	Electric-arc welding.	DECAUVILLE. (French Nord).
Chrome steel . .	50/60 (*31.7/38.1*)	...	...	...	Underframe and body framing.	Welding (and occasionally riveting).	GANZ. (Hungary).
Chrome-copper steel	54/64 (*34.3/40.6*)	18/20	36 (*22.9*)	25/26 (*15.9/16.5*)	Underframe. Body.	Arc or spot welding.	COMPAGNIE FRANÇAISE. (Paris-Lyons-Mediterranean, France). DE DIETRICH. (Alsace-Lorraine Railways).

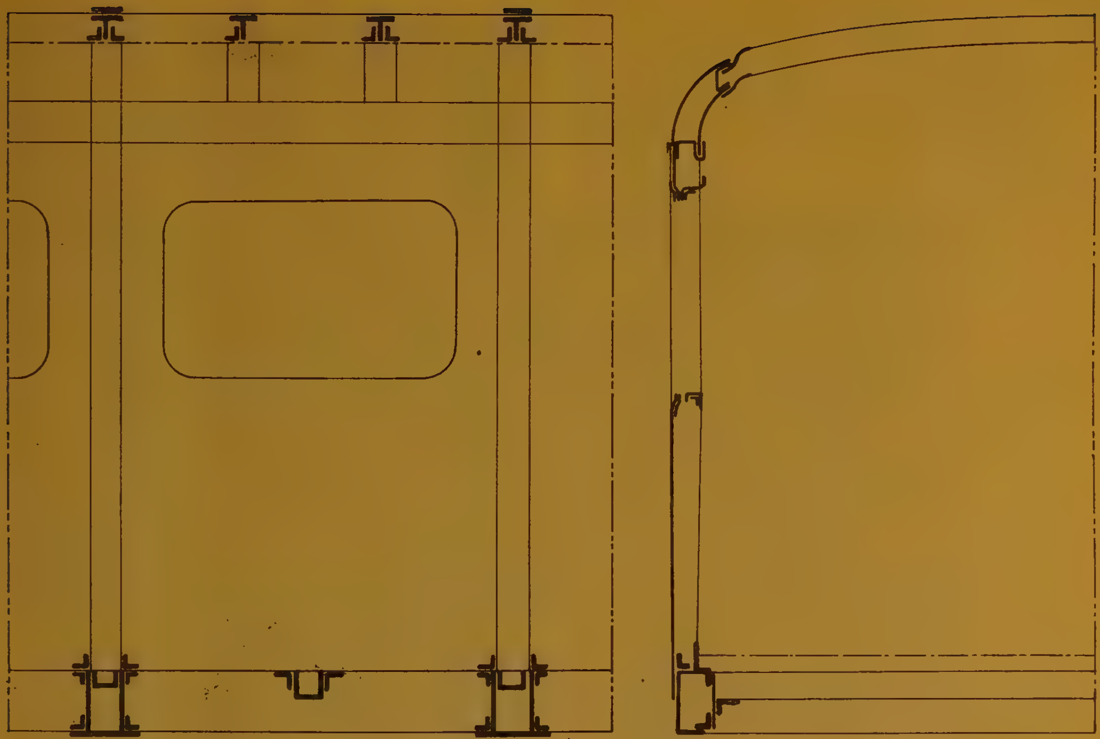


Fig. 11. — Railcar built by the ENTREPRISES INDUSTRIELLES CHARENTAISES (French State). Framing made of light alloys.

a body bolster in cast steel over the bogie centre pin.

Another example is to be found in certain Belgian railcars in which the ends of the underframe are of cast steel.

The usual rolled sections used in metal construction are being given up more and more as leading to excessive weight relatively to the strength obtained.

Most of the framing and the linings are pressings from plates. As, however, presswork involves special and expensive plant, a large number of pressings must be made to meet the initial expenditure. Consequently, many builders prefer to use bent plates, except when the complicated forms of certain end plates, for example, justify the necessary press tools for a few parts (see fig. 12, the framing of a RENAULT rail motor car).

An interesting example of the use of tubes is to be seen in the body framing of the AUSTRO-DAIMLER fast rail motor cars on the Austrian Federal Railways (see fig. 13).

The body framing of the Dutch triplets is another example of a particular form of construction using tubes : the underframe and the body consist of tubes of the Mannesmann type in 0.25 % copper bearing steel, of circular or rectangular section, obtained either by hot-drawing or from bent plates welded together. As the parts cannot be riveted together, all units are assembled by electric arc welding (see fig. 14, an example of assembly).

4. Methods of assembly.

The parts in many cases are riveted up with the exception of such parts as the underframe, which have to stand large stresses. Welding is then an auxiliary process, its use being determined by the ease with which it can be done (Belgian railcars).

Some builders, however, have deliberately adopted welding.

For example :

— the C. K. D. railcars of the Czechoslovak State Railways, in which the longitudinal and cross members of the underframe are welded electrically, while the floor is riveted to the underframe.

— Figure 15 shows the body of a Fiat rail motor car wholly assembled by electric arc welding or butt welding in the case of heavily stressed members, electric spot or continuous welding for less important parts of the framing and for securing sheet panelling.

— The 4- and 8-wheeled Skoda railcars of the Czechoslovak State Railways (fig. 16) which are completely assembled by electric continuous welding.

Gas welding is little used, and the general tendency has been towards electric welding under all forms.

IV. — Description of certain modern railcar underframe-body units.

1. Rigid frame, light body.

Bugatti (France).

a) *Underframe.*

The underframe consists of two pressed-steel sole bars 8 mm. (5/16 inch) thick, the form being that of a girder of equal strength. These two sole bars are cross-braced in an absolutely rigid manner by intermediate cross bearers, also made of pressings, riveted to the soles.

In line with the centre pins there are

Fig. 12. — Body framing of Renault railcar.

two intermediate cross members placed close together, forming a very strong caisson which acts as the centre bolster.

b) *Body*.

The all-steel body consists of 5 independent sections, the middle one, which contains all the motor equipment; the driver's cabin; the luggage compartment, and the lavatory; the ends, of special shape, and the two intermediate sections. These five sections are assembled together by rubber blocks, which are heavily compressed by the tightening up of bolts.

Fig. 13. — Body framing of Austro-Daimler railcar.

These five parts can therefore move relatively to one another, but the tightness of the whole is obtained by the compression of the rubber blocks.

The intermediate sections each have a door on either side of the vehicle; this door, in pressed plate, opens outwards; it is fitted with a safety lock. Each part of the body is built up of a certain number of girders in double T section braced together by rolled sections of the same form, assembled by butt-welding.

The sides and the roof are plated inside and out with « Celotex » (compressed cane fibre) between.

The body is carried on the underframe by a certain number of cup shaped supports secured to the sole bars, and in which rests a spherical pivot attached to the body. A block of indiarubber is placed between the pivot and the cup (cf. fig. 1).

The unit has two compartments, each of which can hold 24 passengers, connected by a gangway without doors.

The side corridor gives access to the driver's compartment, the luggage compartment, and the lavatory.

The seat backs are reversible to meet the passengers' wishes.

The windows are fixed and fitted with safety glass.

24- and 56-seater Michelines (France).

The frame and body of the 24-seater Michelines consist of a series of trellis

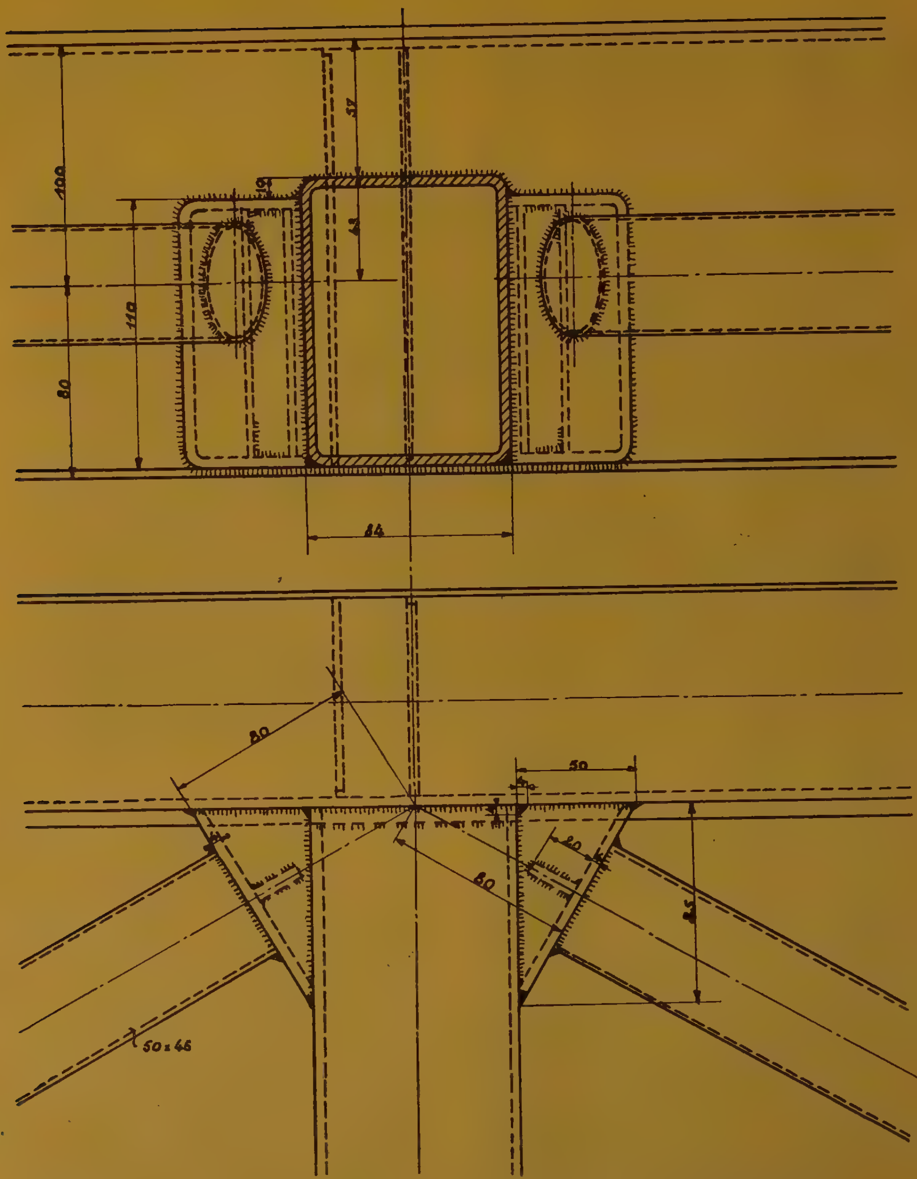


Fig. 14. — Dutch triplet — Example of assembly (welded tubes).

girders cross-braced by the carlines and cross stays.

The whole is fastened by four links to the bogie frames. The body framing is assembled by riveting the thinner parts in bent plate, and by welding in the case of the tubes.

The panelling (light plate lined inside

Fig. 15. — FIAT railcar (Italy). — Underframe and body framing.

with imitation leather) in no way adds to the shock-resisting strength.

This ultra-light construction adopted to reduce the load on the pneumatic tyres has been given up in the later larger capacity vehicles.

Indeed, the 56-seaters have rigid frames in bent or pressed sheet steel (fig. 2). The sole bars have a large moment of inertia. The body is built up of pressed aluminium sheets, bolted together, and bolted to the underframe, impregnated wood laths being inserted between the two parts.

The frame is carried on two bogies on which it rests on 8 supports (4 per bogie).

Whilst the construction remains extremely light, it shows a development towards a more rigid type of vehicle, as is shown by the following figures :

Weight per metre (per linear foot) of body length :

24-seater *Micheline* : 558 kgr. (1 230 lb.).
56-seater *Micheline* : 788 kgr. (1 737 lb.).

4- wheeled SKODA railcars, Czechoslovak State Railways.

The underframe is electrically welded; the sole bars are of the lattice type; their lower flange is made of steel tubes and also acts as a compressed-air brake pipe. The upper flanges and cross

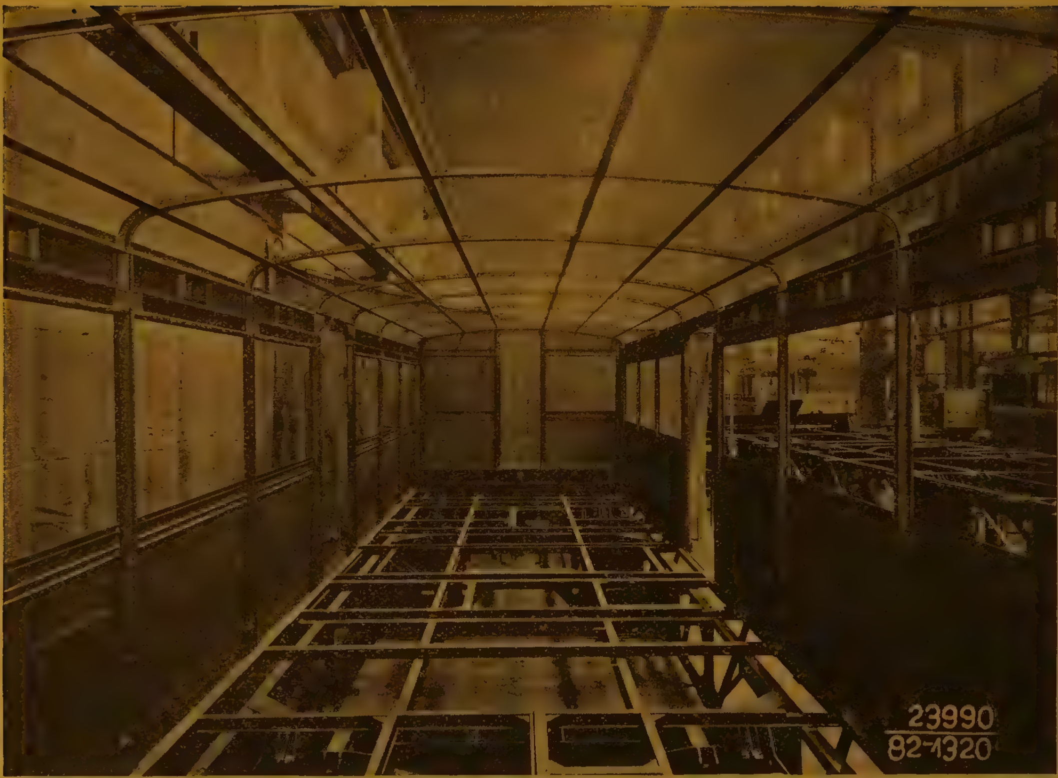


Fig. 16. — Skoda railcar of the Czechoslovak Railways.
View of underframe and body framing.

bearers are angle bars. The solebars are cross-braced by plates carrying the body.

2. Body and underframe forming a rigid unit.

« La Brugeoise » (Belgium) twin railcar.

This set consists of twin units of streamlined form.

The two bodies are metal and form two rigid tubular girders carried on three bogies, wood being used for lining out the interior only.

The underframe and the sides are in steel, and the roof is built up of steel and light alloys.

In buildings the units, large use has been made of rolled sections and pressed plates, assembled by riveting or by electric continuous welding.

Special high-tensile steels were not used; rustless steel, aluminium and its alloys, have been used for fittings, for the roof, and for certain details.

Schnelltriebwagen (Germany).

The underframe is formed of Z bars which run straight through in line with the doors. The two longitudinals forming the lower frame are connected by light cross members of U shape. The ends are strengthened by strong caissons which act as buffers by the simple addition of two hemi-cylindrical blocks of

indiarubber carried in two side buffer cases. The roof skeleton is completed by transverse members tied together by the side walls, which in this way add to the rigidity of the body.

The outside panelling is steel plate 2 mm. (5/64 inch) thick below and 1.5 mm. (1/16 inch) thick above the waist rails.

The roof arch is made of rounded plate 4 mm. (5/32 inch) thick, which is also used for the turned-down ends of the roof. The middle part of the roof, which is slightly curved, is made of 6-mm. (15/64 inch) plywood covered with two thicknesses of special fabric.

The inside of the body is covered in 3-mm. (1/8 inch) plywood.

When building the body frame ample use was made of « St 52 » (33 Engl. tons tensile) steel, which can be classed among the chrome-copper steels, the different parts being welded together whenever possible.

Dutch triplet sets.

The body skeleton has been built up from tubes of rectangular section, which were preferred to rolled sections in order to reduce the weight without diminishing the strength. These tubes have been obtained, starting from the Mannessman circular-section tubes, by hot drawing, which gave them the required rectangular section. Il appears that their price is not much higher than that of ordinary rolled sections.

The whole of the tubes is assembled by electric welding; the side panels are also welded to the body framing. The centre body has been built up more strongly in view of the weight of the motor equipment carried in it.

The ends of the train are streamlined to reduce the air resistance.

In addition, the sides of the bodies are continued downwards by a petticoat in sheet steel which covers the running gear, to prevent the formation of eddy currents under the body.

Special steels have not been used; ordinary copper bearing steel has been used exclusively.

Ganz railcars (Hungary, Belgium).

This builder has adopted, for his modern railcars, the type of frame and body which forms a rigid girder of the *Vierendeel* type, with 2 or 3 supports.

The underframe alone is designed to take all shocks, should the vehicle be involved in a collision.

The main parts, the underframe and the body framing, are very much strengthened by the steel panellings of the body which are welded to the underframe and act as gusset plates, as do the curved roof plates.

The body pillars are riveted or arc-welded to it the whole depth of the sole bars. Chrome steel of 50/60 kgr. (31.75 to 38.1 Engl. tons) tensile strength (see table II) is used throughout.

Fiat (Italy) (see fig. 15).

The underframe and the body skeleton are one rigid unit although very light, and are carried on two bogies through two cast-steel body bolsters.

The body is carried on each bogie by means of two metal plates lined with indiarubber, resting on 4 steel rollers secured to the bogie sole bars. The bogie centre, embedded in a rubber pad, is a spherical bearing.

Except for the upper part of the roof and the two ends, which are covered with aluminium sheeting, ordinary steel is used throughout.

The body framing is mainly built up of rolled-steel sections.

Franco-Belge (Nord Railway, France).

a) *Body framing.*

The whole of the body and underframe forms a tubular structure based on the principles adopted in the case of all-metal coaches for fast trains.

The underframe consists of two sole bars of U shape, of pressed steel 4 mm. (5/32 inch) thick, which are rounded at the leading end; they are cross-braced by pressed cross bearers electrically welded, and riveted together.

The body is built up of steel members 3 mm. (1/8 inch) thick, also of pressed steel, and is welded and riveted.

The side panels of the body are riveted along their lower edge to the top of the sole bar; the joint is completed by electric continuous welding.

The roof consists of steel sheeting 1.5 mm. (1/16 inch) thick.

b) *Outside shape of the body.*

The outside shape of the body was the outcome of many tests on models in the wind tunnel. It takes into account the fact that the rake has to run in both directions.

These tests have led to a removable screen in duralumin sheeting, being fixed under the frame, which closes in as far as possible the running gear.

The side lights, which are fixed, are set back 4 mm. (5/32 inch) only from the outside; the design of the doors also coincide with that of the outside of the body, so as to prevent the considerable increase of air resistance resulting from the usual setting of the lights. In the same way, the train lights do not project and are protected by glass which forms a practically continuous surface with the walls. Finally the exhaust chimney has been streamlined.

Thanks to these precautions an air resistance coefficient of 0.32 has been obtained for the models in the air tunnel, whereas the same coefficient for an ordinary railway vehicle may be as much as or even exceed 0.80.

4-WHEELED SKODA RAILCAR
(Czechoslovak State Railways).

The underframe, the body frame and the inside sheet panelling are electrically welded and form one solid unit. The lower part of the railcar is shrouded in by a petticoat of sheet metal, which reduces the air resistance when running.

* * *

CHAPTER X.

ARRANGEMENTS.

I. — Sound and heat insulation of the passenger compartments.

1. Sound insulation.

The suppression, or rather the reduction, of noise and vibration inside compartments is an important factor in making railcars comfortable.

The suppression of noise is a very complex and delicate problem which requires a careful and methodical investigation; this problem has many resemblances with that which arises in aircraft and some of the conclusions come to by the engineers specially dealing with noises in aircraft, Mr. Stephen ZAND, for example, might well be adapted to railcars.

Practically, noise would be diminished :

a) by a reduction of the vibrations;

b) by a reduction in noise transmission through the various parts which make up the vehicle;

c) by absolute tightness of the walls.

a) *Reduction of vibrations.*

To damp out the vibrations which are transmitted to the passenger compartment, it is necessary to break the continuity between the different sources of vibration and the inside of the body, and

TABLE III.

HEAT-INSULATING AND SOUND-DEADENING MATERIALS.

Usual description.	*Nature.*	*How supplied.*	*Used for.*	*How fastened.*	*Remarks.*
Wood.	Poplar.	Boards or plywood.	Floor itself.	Nailed.	Usually covered with linoleum, with or without additional heat insulation.
Compressed cane fibre.	Compressed cane fibre.	Sheets or strips.	Lining body sides or roof (usual). Sometimes used as an additional floor covering.	Glued or nailed (nails with welded heads and points burred). Screwed down with washer.	...
Compressed cork.	Cork.	Do.	Lining sides, floor and roof.	Nailed. Glued.	...
Cork scrap.	Cork.	Pieces.	Lining the sides and roof. Lining corrugated sheeting carrying the floor in some railcars.	Sprayed with compressed air gun after coating with paint.	Denmark.
Alfol.	Crumpled aluminium sheets.	Sheets.	Lining body sides and roof.	Held in place by wires.	For heat insulation exclusively.
Asbestos scrap.	Asbestos.	Pieces.	Side and roof sheeting.	Sprayed with compressed air gun on previously tarred plates.	Drawback that covering softens in summer (inside paint stained).
Rubber carpet.	Ordinary rubber. Sponge rubber.	Sheets or strips.	Floor covering.	Laid or nailed.	Rubber sheets usually used as a vibration absorber under a carpet or linoleum. In some cases the rubber forms the top covering.
Linoleum.	...	Do.	Do.	Do.	
Felt.	Wool or cotton.	Roll.	Lining floors and sides.	Simply inserted or glued.	...
Compressed wood wool.	...	...	Lining roof, sides, and floor.	...	Finland.

this is done by inserting blocks of indiarubber between different parts of the railcar :

1. Between the tyres and the axles, which gives the elastic wheels. The various methods used so far have not given full satisfaction, except the pneumatic tyres used on the MICHELINES, and to a lesser degree, wheels of the DAIMLER type.

2. Between the body and the running gear.

3. Between the engine and its support. This latter precaution is particularly

important if the engine is inside the body.

b) *Transmission of noise by conduction through the various parts of the railcar.*

Noises transmitted in this way can be reduced by the use of rubber as above; but to reduce them still further, the use of quite special sound-deadening materials would be desirable. Systematic tests ought to be made to classify the sound-deadening values of the different materials used.

Table III gives the essential data for the various materials in ordinary use.

The railcar floor construction plays an important part, and among the methods used to prevent noise being transmitted through the floor, the following may be mentioned.

1. Corrugated steel sheeting lined on its upper face with compressed cork, to provide a level horizontal surface covered in turn by an insulating material on which linoleum is laid.

2. The use of a double floor, the air imprisoned between the two parts providing an excellent insulation.

The principle of an air gap between the inner and outer walls is also used for the body sides and roof.

c) *Transmission of noise by the surrounding atmosphere.*

To minimise as much as possible the noise so propagated, the railcar should be made as airtight as possible, as noise penetrates through the smallest opening. Too often have the builders been satisfied with covering the engine with a metal bonnet, either single or double, and also separating the engine compartment from the passenger compartment by a luggage compartment forming an air lock.

2. Heat insulation.

No systematic investigation has been made into heat-insulation materials and methods in connection with railcar bodies; most frequently the arrangements adopted against noise transmission are used at the same time to reduce heat exchanges.

The materials used, with their principal characteristics and the way they are employed, are shown in table III.

II. — Windows and doors.

When dealing with fixtures it is relatively easy to make the vehicle air- and watertight; the doors and windows, however, which open, have to be absolutely tight when shut, and at the same time only require the minimum effort to be opened or shut.

Drop lights can be divided into several classes as regards arrangements for providing tightness :

a) *Fully sliding light*, dropping into the case below, with felt or rubber packing.

Water is allowed to enter into the casing below the windows and escape freely from it; evaporation is hastened by the air current through it (A. D. N. of the French Railways).

b) Only the top part of the window is moveable, and slides in front of the other half; a simple band of rubber makes the joint between the two half lights, and in the channel of the moveable half light when shut.

The lower panel of the window can easily be made watertight (certain A. D. N. and RENAULT railcars on the French Railways).

Method of operating moveable lights.

In railcars of older types, the light was opened or shut by a leather strap, but all up-to-date rail motor cars are fitted with a winding-up gear of the automobile type, usually with a spring equalising device.

These equalisers are housed under the light if this can be fully dropped.

In some cases the moveable half lights are fitted on the sides with clips engaging in the side racks (RENAULT, France).

Doors.

The doors, when shut, are made tight in most cases by special rolled sections in rubber.

The doors usually are hinged, opening either inwards or outwards.

Certain railcars are fitted with sliding doors (Holland, Belgium, French A. D. N. railcars). Others have folding doors of the « portfolio » type (doors into the luggage compartment on the French Renault).

In all cases, the doors are either fitted with a safety lock or a double-action lock.

On certain railcars in Italy and Hungary, the driver can ascertain, thanks to an electrical device, that all the doors are shut.

Kinds of glass used.

All the railways use safety glass for the driver's compartments. « Triplex » is preferred to tempered glass, because after having been broken by a shock it retains sufficient visibility for driving.

In this connection mention may be made of the « Sigla » glass, used in Austria, which does not become translucid like the « Triplex », nor explode like the « Securit ».

As regards passenger compartments, safety glass is not usually imposed by a government regulation. Its use, however, is becoming general in the form of tempered glass, of which « Securit » is the prototype in France.

III. — **Interior fitting out.**

Passenger compartment.

From the operating point of view, railcars can be divided into two classes :

— Accelerated local trains on secondary lines with little traffic;

— Express trains between large centres relatively short distances apart.

In these two cases the time the passengers are in the vehicle does not exceed a few hours, and consequently the interior arrangements can be made simpler than on main-line stock. In particular, most railcars have only one bay without any partitions between the various compartments.

The interior arrangement thus very often approaches that of a modern road motor car. The compartments are fitted either with fixed seats, with fixed backs, seating two or three, covered with imitation leather or fabric (1st class) (see fig. 17), or fixed seats with movable backs, or again individual reversible seats (see fig. 18).

For some time a special investigation has been undertaken to improve the reversible seats enabling passengers to always face the running direction.

* * *

Triplet railcars.

We deemed it interesting to give hereafter, grouped on one plate (fig. 19), the diagrams of the various triple-unit rail motor sets now in service or under construction, namely :

Reichsbahn — electric or hydraulic drive — under construction.

Belgian National Rys. Co. — electric drive — under construction.

Danish State — electric drive — under construction.

Nord (France) — electric drive — in service and under construction.

Netherlands Rys. — electric drive — in service.

Italian State — mechanical transmission — under consideration.

Messrs. Michelin, Bugatti, and Renault, have just put into hand triplet sets for the French State Railways.

IV. — **Meals served in railcars.**

Several railways provide light meals in some of their railcars.

As the companies wished to carry the greatest possible number of passengers, the space set aside for these services was

Fig. 17. — FIAT railcar (Italy). — Interior arrangement.

so small that the installation has been particularly difficult to carry out. Then, too, the weight of the equipment and accessories, as well as the fuel to be used, has made the problem still more complicated. However, the question has been very elegantly solved, and we give below an enumeration of installations in service at the present time, as well as of others for railcars under construction.

Railcars actually in service.

The BUGATTI twin railcars of the Paris-Lyons-Mediterranean and the FRANCO-BELGE triplet sets of the French Nord are now provided with a restaurant equipment (worked by the International Sleeping-Car Company). The space reserved for the buffet-kitchen is very small and the staff has to use Butane gas stoves when preparing hot drinks or dishes.

A bar has also been installed on the SCHNELLTRIEBWAGEN so that cold and hot drinks can be served, the hot drinks being heated electrically.

Railcars under construction.

The International Sleeping-Car Company is at the present time designing the equipment of three types of railcars under construction : FRANCO-BELGE triplet sets of the French Nord Railway, the triplet sets of the Danish State Railways, and those of the Italian State Railways.

Fig. 18. — BUGATTI railcar (French State Railways). — Interior arrangement.

The space provided for the buffet-kitchen on the French Nord triplet sets is larger than that on the rakes in service, and the Butane gas stove has been replaced by a Butane gas oven; passengers will be able to order the same meals as in the dining cars.

On the Danish triplets only very simple meals and dishes are served, the stove and kettles being electric, as is the ice machine.

In the case of the Italian State triplets, the space set aside for the kitchen and pantry is similar to that of the Pullman cars and the installation, though not definitely decided upon, will be similar to those on the Pullmans.

The triplets now under construction for the Deutsche Reichsbahn are also being fitted up with a buffet.

* * *

CHAPTER XI.

HEATING AND VENTILATION.

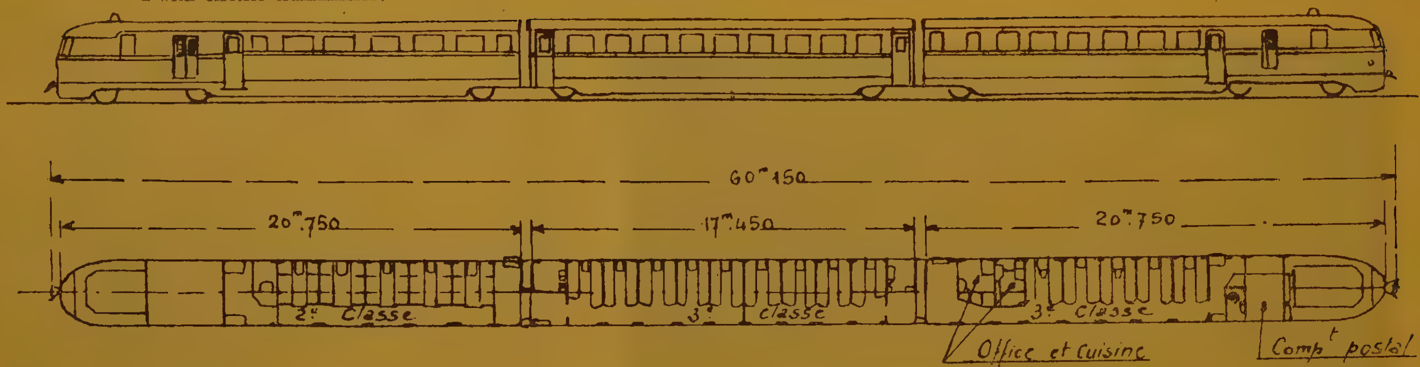
A. — Heating.

Most builders endeavour to use the heat in the diesel engine exhaust, not

GERMANY (5 under construction).

Two 600-H.P. diesel engines.
3 with hydraulic transmission.
2 with electric transmission.

Number of seats { 2nd class : 30. 3rd class : 109.

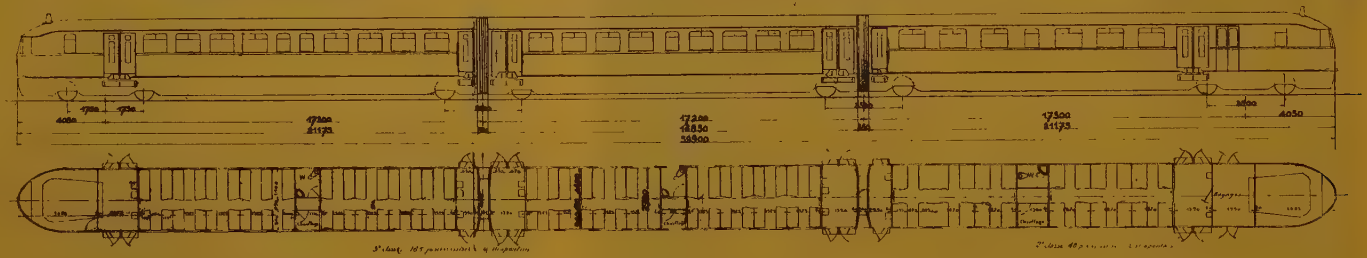


Note: Office et cuisine : pantry and kitchen. Compt postal = Post Office compartment.

BELGIUM (8 under construction).

Two diesel engines, 400 H.P. (approx.)
Electric transmission.

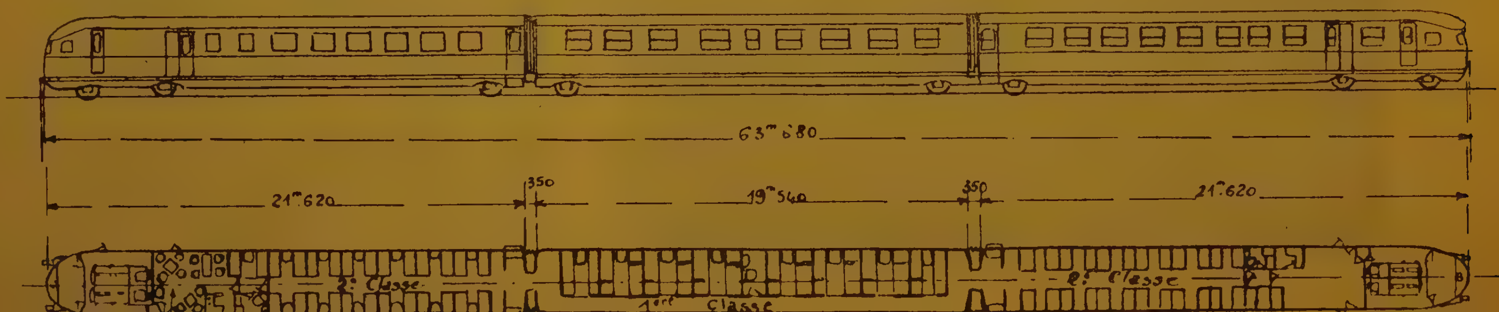
Number of seats { 2nd class : 50. 3rd class : 179.
Weight : 118 t. (116.1 Engl. tons).



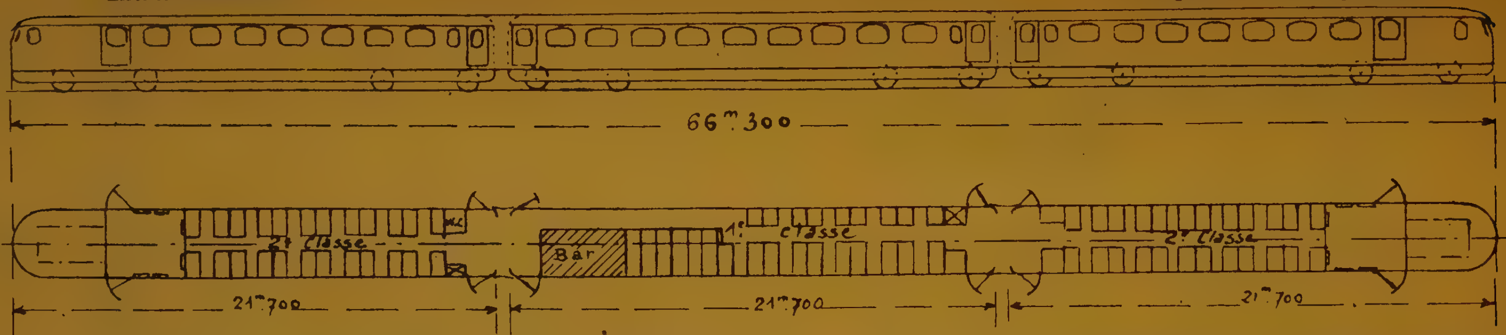
DENMARK (4 built, in service from 15th May).

Four 275-H.P. diesel engines.
Electric transmission.
Weight of set : 118 t. (116.1 Engl. tons).

Number of seats { 1st class : 36. Common class : 108. Restaurant : 12.
Weight (design) : 118 t. (116.1 Engl. tons).



Electric transmission. FRANCE (3 under construction, 1 in service). Weight : 124 t. (122 Engl. tons).

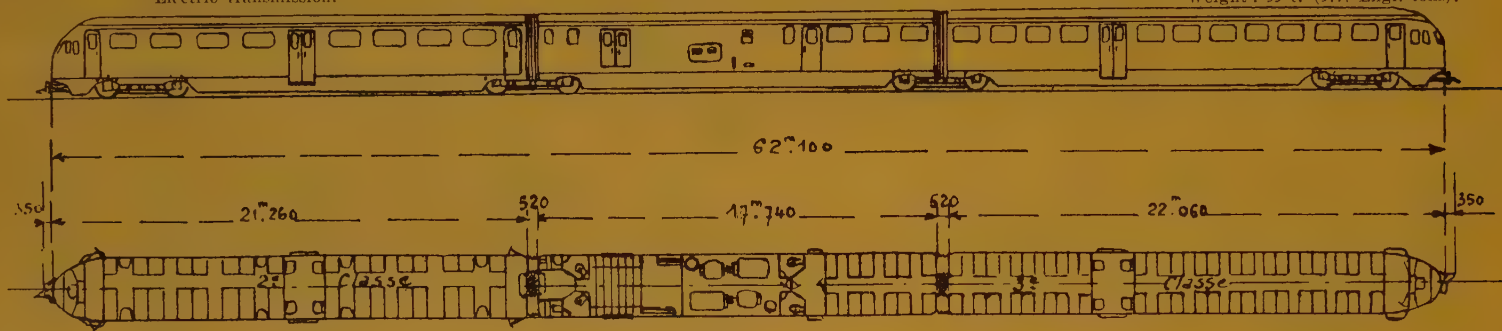


Note : « Bar » in the middle vehicle should be read « Cuisine » (kitchen). Furthermore all vestibule doors except at both ends open inside instead of outside as shown on the diagram.

Two 410-H.P. diesel engines.
Electric transmission.

HOLLAND (40 in service).

Number of seats { 2nd class : 48. 3rd class : 112.
Weight : 99 t. (97.4 Engl. tons).



Engine compt.

Two 400-H.P. diesel engines.
Mechanical transmission.

ITALY (projected).

Number of seats { 1st class : 36. 2nd class : 56.
Weight (anticipated) : 75 t. (73.8 Engl. tons).

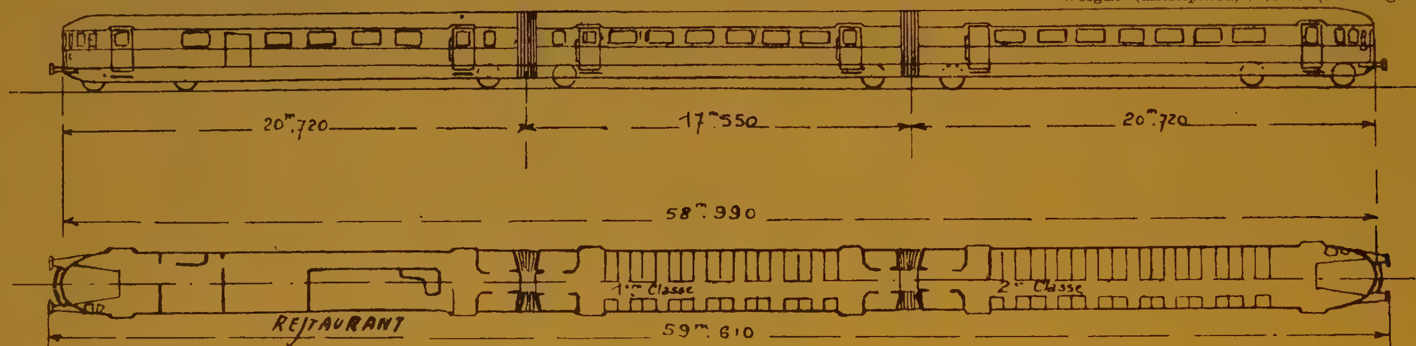


Fig. 19. — Diagram of triplet railcars of various countries.

transformed into energy, for heating their railcars.

Certain builders have, however, preferred not to run any risk of interfering with the working of the engine, and have therefore installed hot-water heating from an independent boiler, a method which is essential in districts where there are wide differences in temperature, or when it is desired to make quite sure that the railcars will be properly preheated.

The methods generally employed for heating railcars can be classified under four headings :

1. — Heating by the exhaust gases;

2. — Heating by the engine cooling water;

3. — Heating by hot air, the temperature of which is raised by :

a) the exhaust gases;

b) the cooling water.

4. — Heating by means of an independent boiler.

1. Heating by the engine exhaust gases.

This method has the advantage of being economical and not requiring any special installation.

On the other hand, the heating power obtained is obviously limited, as it depends directly upon the way the engine is working, so that it may be insufficient in periods of severe cold, or in less cold weather during the descent of long gradients on which the engine is not developing any power.

This type of heating is generally used :

1. On petrol railcars, on which the number of heat units available is greater than in the case of a diesel engines;

2. On diesel railcars the power of which is high for the services being covered;

Heating is by plain or preferrably by finned tubes which latter assist the dispersion of the heat.

The greatest precautions must be taken to ensure these pipes being tight in order to prevent poisonous gases getting into the compartments.

Regulation of the heat is not automatic, and is generally controlled by the driver, by means of a valve which regulates the quantity of exhaust gas admitted into the heating pipes.

It should be noted that this method of heating has a far from negligible influence on the working of the engine, as it impedes the escape of the exhaust gases, and therefore sets up a counter-pressure in the cylinders.

Heating by the exhaust gases is widely used in France [RENAULT railcars; so-called « Standard » railcars of the ACIÉRIES DU NORD (A. D. N.); BUGATTI railcars with four 200-H.P. petrol engines]; in Italy, FIAT railcars; and in Czechoslovakia.

2. Heating by the engine cooling water.

As with the exhaust gases, heating by circulating the cooling water of the engine has a limited capacity, depending upon the way the engine is worked.

In order to meet the lack of heat in cold weather, or when running under low power, the equipment is generally completed in large-capacity railcars by a standby heating plant (hot water heating by means af an independent boiler or electric heating).

Regulation of the heat is sometimes automatic, by means of a thermostat which comes into action as soon as the temperature of the engine water exceeds a certain limit, by diverting part of this water towards the engine radiator.

Preheating is obtained either by the standby heating installation when this is fitted, or by an outside source of steam supplying the normal circuit of the cooling water, or a special preheating circuit.

This method of heating is used in Austria (WIEN-SIMMERING railcars fitted with one 160-H.P. diesel engine); in

France (COMPAGNIE GÉNÉRALE DE CONSTRUCTION railcars, with one 135-H.P. diesel engine; BAUDET-DONON-ROUSSEL railcars with one 105-H.P., C. L. M. diesel engine; CHARENTAISE railcars with one 80-H.P. Junkers diesel engine); in Finland (railcars with one 150-H.P. M. A. N. diesel engine), in Hungary (various designs with diesel or petrol engines), and in Czechoslovakia (various railcars).

3. Heating by air brought to the desired temperature by the exhaust gases or the engine cooling water.

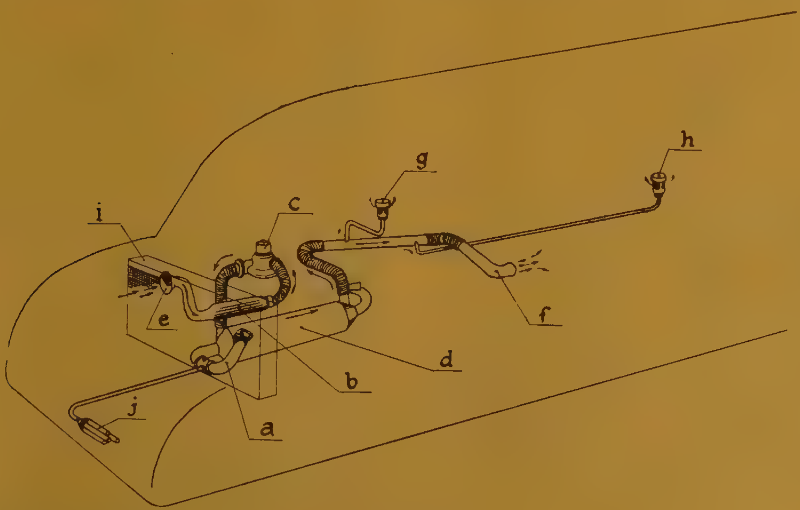
The air coming from the outside is heated :

— either by circulation round the exhaust gas piping,

— or by radiators through which the engine cooling water is circulated.

Both these methods are economical as they do not require any piping being installed, the hot air being admitted into the compartments through ventilating inlets. Circulation of the warm air is obtained through the speed of the vehicle itself, or what is better, by electric fans. These methods combine very well with the ventilation properly speaking of the railcars, and even in the case of the cooling water, with their refrigeration; the latter is consequently particularly interesting in the case of railcars with fixed window lights.

Figure 20 shows the hot-air heating system installed on the AUSTRO-DAIMLER



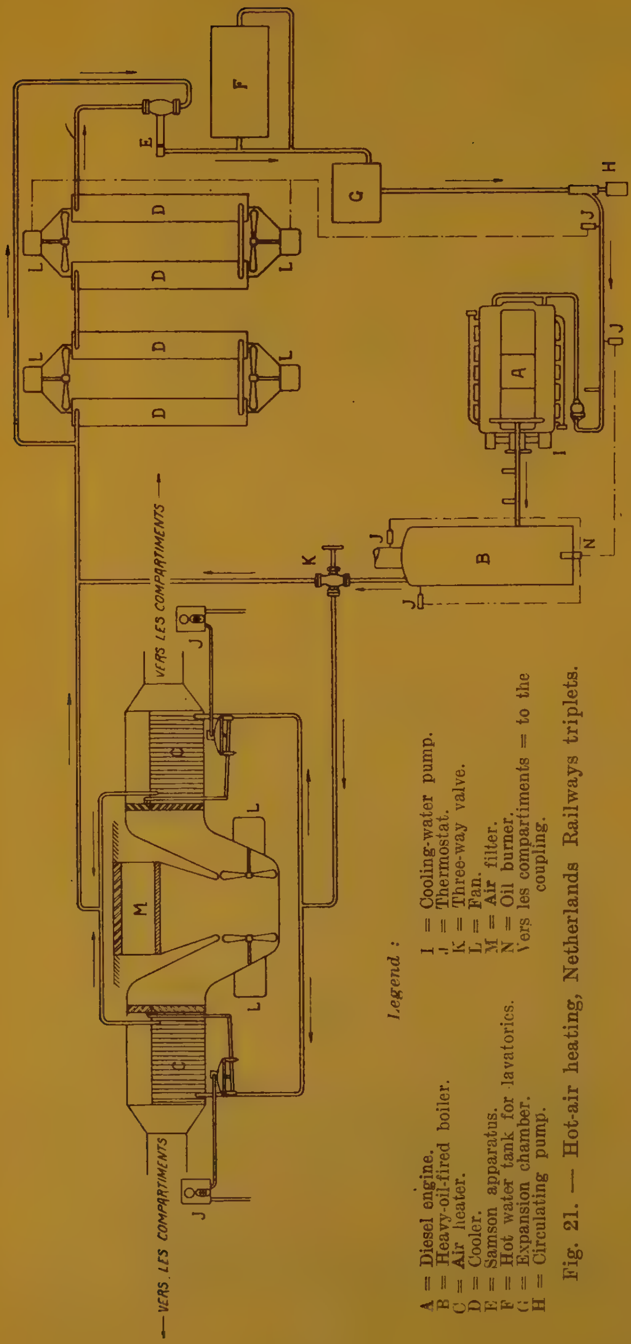
Legend:

a = Exhaust gases from engine.
b = Air from the atmosphere.
c = Fan.
d = Air heater.
e = Suction of air from atmosphere.
f = Warm air main pipe.
g = Warm air inlet into driver's compartment.
h = Warm air inlet into lavatories.
i = Radiator.
j = Warning device (coming into action when the pressure drops).

Fig. 20. — Hot-air heating installation on AUSTRO-DAIMLER railcar (Austria).

railcar with two 80-H.P. petrol engines, of the Austrian Federal Railways.

The outside air, sucked in by a fan, is introduced into a heater, through which the exhaust gases are circulated. A main pipe conveys the heated air



Legend :

A = Diesel engine.
B = Heavy-oil-fired boiler.
C = Air heater.
D = Cooler.
E = Samson apparatus.
F = Hot water tank for lavatories.
G = Expansion chamber.
H = Circulating pump.
I = Cooling-water pump.
J = Thermostat.
K = Three-way valve.
L = Fan.
M = Air filter.
N = Oil burner.
Vers les compartiments = to the coupling.

Fig. 21. — Hot-air heating, Netherlands Railways triplets.

to the compartments, and secondary pipes to the driver's compartment and the lavatories.

The method of heating by hot air heated by the engine cooling water is used in Germany on rail motor cars of various types, in Holland on the triplet railcars with two 410-H.P. Maybach-diesel engines, and in France on the Michelines.

Figure 21 shows the installation on the Dutch sets the working of which is the following :

The cooling water from each engine passes through two radiators in which the air is heated before being introduced into the compartments.

When the weather is very cold, the water from the engines is further heated in an auxiliary oil-fired boiler before entering the radiators.

This boiler is put into action by a thermostat as soon as the temperature of the cooling water on its way back to the engine falls below a certain limit.

4. Heating by independent boiler.

This method, similar to that used in central heating installations, is the one chiefly used for large-capacity railcars, especially for multiple units.

It has the following advantages :

— The power of the boiler is proportioned to the volume to be heated, and consequently it is easy to obtain the desired temperature;
— Flexible working;
— Easy regulation;
— The heating plant is independent and does not affect the working of the engine;
— The equipment can readily be used for prehating the railcar.

The drawback of this heating method is that fuel must be stored and the railcar staff is obliged to keep firing the boiler during the journey, when coke is used.

Furthermore, there are additional fire risks. In principle, such a plant consists of a vertical tubular boiler fired by coke

or gas-oil; the hot water runs into an expansion tank, circulates through the heating pipes and returns to the bottom of the boiler by a return pipe.

The heating circuit consists of a single pipe, finned radiators, or in certain cases ordinary house radiators.

Regulation, when automatic, is obtained by means of a thermostat controlling the draught (coke-fired boiler), or the fuel admission (gas-oil).

The hot water is generally circulated in the heating circuit by means of an electro-pump, fed by the accumulators of the vehicle.

In certain railcars a pipe is provided to take hot water to the engine jacket, so as to heat the engine and make it easier to start.

This method of heating has been applied on a wide scale in Germany (various railcars), in Belgium, in Denmark (FRICHS railcars with two 220-H.P. Frichs diesel engines), and in France (DE DIETRICH railcars with two 100-H.P. diesel engines, S. O. M. U. A. railcars with one M. A. N. 210-H.P. diesel engine, FRANCO-BELGE railcars with two 410-H.P. diesel engines.

B. — Ventilation.

The ventilation of railcars is on the same lines as in ordinary coaches :

— by opening the windows when not fixed;
— by ventilating apparatus.

Railcars are usually fitted with ventilators in the roof.

These act either by aspiration or by feeding air under pressure into the compartment.

The entry or the outlet of the air takes place through the natural interstices and also by the windows.

These devices are usually controlled by the passengers operating disc valves, the opening of which can be varied.

In the FRANCO-BELGE triplet railcars, the windows of which are fixed, ventilation is obtained by lateral ventilators fitted by means of ball-and-socket joints, and which the passengers can set to suit their wishes.

In the 220-H.P. RENAULT railcars, two air inlets at the ends of the vehicle build up the pressure between the inner and outer linings of the body. This air is then distributed into the compartments by adjustable ventilators.

These methods are simple and economical but no ventilation is obtained when the coach is standing.

Fans are more generally used in vehicles fitted with hot-air heating equipment. The air put under pressure by the fans passes over the heating elements before being discharged into the compartments.

The power needed to ventilate the coach varies according to the equipment from 6 to 17 watts per m^3 (17 to 50 watts per 100 cu. feet) to be ventilated; the number of times the air is completely changed per hour should be at least 12.

Ventilation by fans is therefore relatively expensive, but has the great advantage of being available for use when standing, as it is not always possible to open the windows in cold weather.

* * *

CHAPTER XII.

AUXILIARY APPARATUS.

By auxiliary apparatus we mean all plant used to produce the compressed air and electricity required on the railcar for the auxiliaries. We will deal more particularly with the following : air compressors, charging dynamos, accumulators, and starters.

Air compressors.

The air compressors used on rail motor cars are usually piston air pumps and are air-cooled. Their output differs from one type to another, as it is subordinated to the size of the vehicle and to the number of trailers hauled. They supply the brake gear and other auxiliary equipment (sanders, screenwipers, and audible warning devices).

These compressors give from 125 to 1 400 litres (4.4 to 49 cu. feet) a minute. The pressure is 7 to 8 kgr./cm² (99.5 to 114 lb. per sq. inch).

In the case of railcars with mechanical transmission, the compressor is coupled direct to the diesel engine or mechanical transmission, and it is fitted with valves automatically regulating the pressure between two close limits, about 0.5 kgr. (7 lb. per sq. inch).

The Westinghouse Company has built belt-driven compressors which cut in and out as soon as the pressure rises to 8 kgr. and 6 kgr. (114 lb. and 85.3 lb. per sq. inch) respectively. The drive is by a triple belt of trapezoidal section of the Texrope type.

This arrangement considerably reduces the wear of the compressors.

On railcars with electric transmission, the compressors usually fitted are driven by special electric motors.

On some steam railcars working at very high pressure, a special compressor is used, driven by a small high-pressure steam engine (Reichsbahn).

Charging dynamos.

The first railcars were fitted with dynamos of the automobile type. It was soon realised that this equipment was quite inadequate to meet the heavy service required from a railcar. The charging dynamo, indeed, plays a very important part, as it has to maintain a large-capacity battery, the lighting, and frequently to feed the electrovalves of the gearboxes and the reversing gear, as well as of the electro-magnetic brakes.

The capacity of the dynamos, originally 500 watts, has been increased, on certain modern railcars, to 1 800 watts. The voltage is 24. Their characteristics have been improved to enable them to charge the batteries at the idling speed of the diesel engine, and this makes it easy for them to supply the necessary charging current for the accumulators.

As an example, a description of the E. V. R. dynamo and the Bosch dynamo is given below.

E. V. R. dynamo. — The E. V. R. dynamo, a diagram of which is given in figure 22, is fitted with a main regulator and an auxiliary regulator.

The combination of these two regulators makes it possible to charge the batteries at a practically constant intensity during two thirds of the charging time, and after that at constant voltage.

This gives the advantages of constant voltage and of constant amperage without their drawbacks.

This combination is of value when the service covered by the railcar includes frequent stops and therefore involves the diesel engine being frequently restarted, which quickly discharges the battery.

The main regulator is of the comb type; it inserts varying resistances into the excitation circuit of the generator.

The output regulator is a trembler regulator, the contacts of which only cut under a current of some tenths of an ampere. Its electro-magnet is fitted with a main winding through which the total current generated by the dynamo passes, and an auxiliary winding with thin wire.

Thanks to this auxiliary regulator, the output cannot exceed the intensity for which it is adjusted; it is even possible to cut out one or two elements of the battery without the current exceeding its normal value. The most important advantage of this arrangement is that the battery can be charged up quickly and this is equivalent to making better use of the dynamo capacity.

Moreover, with this arrangement a

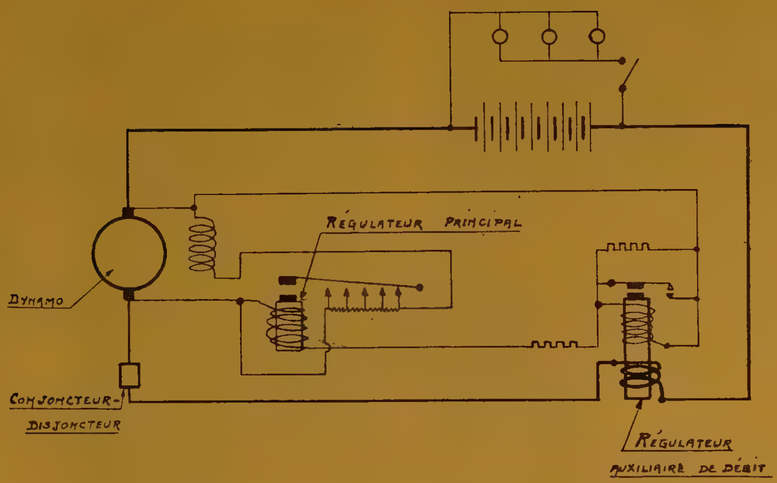


Fig. 22. — The E. V. R. equipment. — Principle of design.

Explanation of French terms:

Régulateur principal = main regulator. — Conjoncteur-disjoncteur = self-closing circuit breaker. Régulateur auxiliaire de débit = auxiliary output regulator.

battery of accumulators can be charged with two dynamos in parallel, a feature of particular value for two-engined railcars with mechanical transmission.

Bosch dynamo. — The Bosch dynamo has a six-pole field magnet system in shunt with the armature, through a voltage and amperage regulator.

The voltage regulation is obtained by a double regulator; the excitation is obtained by two distinct windings, each circuit passing through a regulator. The voltage is regulated by inserting an additional resistance in the excitation circuit by a pair of contacts (fig. 23).

This additional resistance is wound on the core of the trembler coil and makes and breaks the contact at high frequencies.

This core also carries a voltage and amperage winding, through which the total current generated by the dynamo flows.

This regulator gives a charging characteristic independent of the speed of rotation within very wide limits : 1 000 to 4 000 r.p.m.

On railcars with electric drive, the problem of charging the batteries is much simpler.

If the auxiliary generator helps to regulate the electrical equipment, the battery is charged at constant voltage through a resistance; the excitation is corrected to suit the different working conditions of the diesel engine.

In other cases, the characteristics of the auxiliary generator are suitable for charging the accumulators and, as in the previous case, the excitation is adjusted to suit the working conditions of the diesel engine. These adjustments are made either by contactors, or directly by the railcar driver.

Accumulators.

Railcars with internal-combustion engines are fitted with a battery of accumulators, this being one of the essential

fittings. Indeed, the battery is used to start up the diesel engine and to light the vehicle. On railcars with electric transmission, the voltage of the auxiliaries is relatively high (96 or 115 volts), so the battery problem is easily solved. The engine is started by the main generator and the current intensity does not exceed the amount compatible with keeping the plates in good order.

The problem is quite a different one when mechanical drive is used; the 24-volt tension generally adopted involves the use of very-high-capacity batteries such as 400 to 500 ampere-hours. The starting current strength for the diesel engines reaches 2 400 amperes, so that these batteries work at 5 to 6 times their nominal capacity.

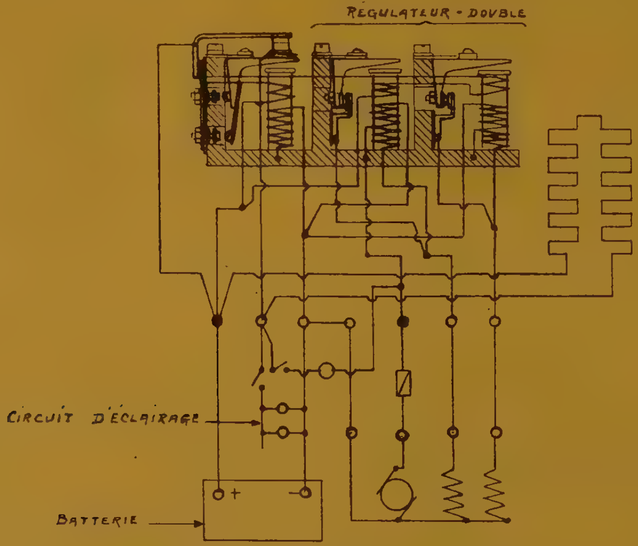


Fig. 23. — Bosch dynamo regulator.

Note: Régulateur double = double regulator. — Circuit d'éclairage = lighting circuit. — Batterie = accumulators.

Up to now, lead accumulator plates have been used and also alkaline batteries, the advantages and drawbacks of these types being well known. The alkaline batteries appear to be preferred by many railways.

Starters.

The diesel engines are in most cases started electrically; for this purpose series-excitation electric starters, fitted with suitable equipment, are used to engage without shock the starter pinion with the toothed ring and disengage it as soon as the engine fires; the release should occur automatically and with precision, as the armature would otherwise be driven by the diesel, and its rotational speed could break it down.

The power of the starters depends on the size of the engines, the number of cylinders and their design. As a rule, starters of 6 to 15 H.P. are used, and sometimes several starters are coupled in parallel under the same toothed wheel.

Scintilla starters. — The Scintilla starter has a series winding and an auxi-

liary winding. The latter is in series with the rotor, and rotates the starter in the opposite direction to normal running and at reduced speed.

In addition, an electro-magnet is mounted on the armature spindle, and causes the pinion to engage with the toothed wheel (fig. 24).

As soon as the pinion is engaged, a contactor allows the current to flow through the principal windings of the starter which begins to revolve in the normal direction and starts the diesel engine. The combined action of the field winding and the principal winding limits the speed of the starter.

As soon as the diesel engine starts the current must be cut off. A roller coupling between the spindle and the pinion prevents the motor from driving the starter at too high a speed once it is started.

Bosch starter with sliding armature. — The Bosch starter includes an armature which, when at rest, is out of

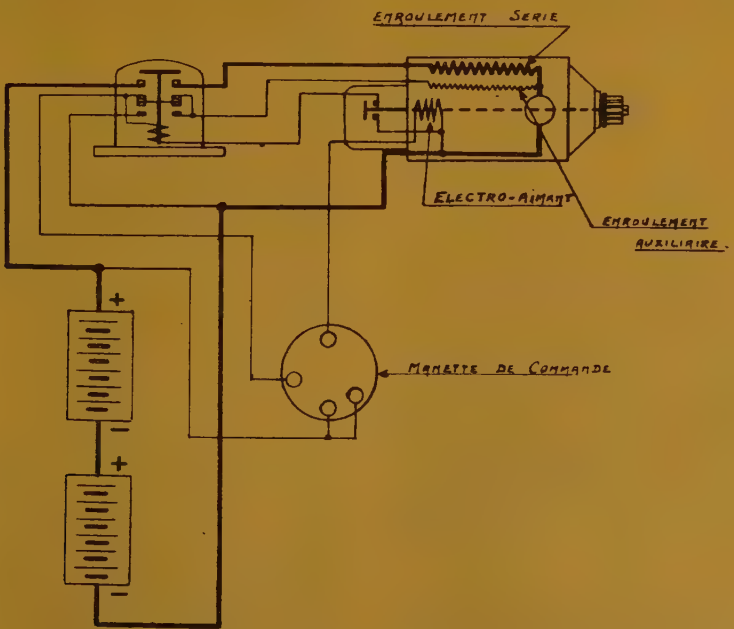


Fig. 24. — The SCINTILLA starter. — Principle of design.

Note: Enroulement série = series winding. — Electro-aimant = electro-magnet. — Enroulement auxiliaire = auxiliary winding. — Manette de commande = control handle.

centre relatively to the poles. The induction system consists of a series winding, a shunt winding, and an auxiliary winding. The engagement of the pinion with the toothed wheel of the diesel engine is obtained by moving the armature. The latter, when moved, only rotates at low speed, which makes it easy to engage the teeth of the pinion with the toothed ring on the motor.

When the starter pinion and the toothed wheel are well in mesh, the starter itself automatically begins to revolve and develop the full power required to start the engine.

As soon as the diesel engine is run-

ning and the speed of the toothed ring exceeds the speed of the starter, a multiple-disc clutch at one cuts off the connection between the starter pinion and the armature, thereby making sure that the latter will not revolve at a dangerous speed. As soon as there is no pressure on the pinion, the armature of the starter returns to its normal position, as the shunt and auxiliary windings are not sufficient to overcome the action of the check spring.

* * *

CHAPTER XIII.

FIRE PRECAUTIONS.

Proper fire organisation includes, on the one hand, preventive measures the object of which is to reduce the risk of fire to a minimum by eliminating the causes and by retarding its spread, and on the other, the placing at the disposal of the staff concerned of adequate means for extinguishing fires at their outbreak.

A. — Preventive measures.

I. — Suppression of the causes of fire due to the railcar.

We will examine hereafter the main parts of the railcars which require special precautions.

1. Engine.

Petrol engines carry in themselves a very serious cause of fire outbreaks, which diesel engines are free of, namely back firing into the carburetter, due to the engine being badly timed, or to defective carburation. This is overcome by fitting the carburetters with antiflame devices, by careful selection of the fuel, and by filtering it on the vehicle before use.

With the diesel engine, as well as with the petrol, it is most important to prevent :

a) leakage of fuel or lubricating oil which, when falling on the exhaust pipes are apt to catch fire;

b) the passage of the exhaust pipes near parts made of inflammable materials of which may be impregnated with inflammable liquid.

The exhaust pipe is very often insulated, but when asbestos is used care must be taken that it does not become saturated with fuel. The best precaution would appear to be to cover the exhaust pipe with an additional cover in steel plate at the critical points, at the same time arranging a current of air to circulate between the lagging and cover.

2. Electric circuits.

Electric short circuits are frequent causes of fire : they may be due either to a wire breaking through mechanical causes (vibration) or through a breakdown of the insulating material through oil, and above all gas-oil.

Mechanical fractures produce short circuits on railcars chiefly when the return is made through the ground. In this case the wires should be arranged to run in covered or insulated and fireproof tubes.

Wires exposed to the action of gas-oil, under the bogie (electro-magnetic brake) or near the motor (dynamo and starter) ought to be protected by insulating coverings which are not affected by oil, of the « souplesso » type. When such protection is given particular care must still be taken to watch the condition of the sheathing, as the smallest crack in it is an open door to corrosion.

Up to the present, the builders have generally been satisfied with keeping the electric circuits away from the parts of the railcar where leakage of fuel and lubricating oil is to be feared; some of them have mounted them in special steel channels (FINNISH State Railways).

3. Brakes.

The bad working of a brake (shoe or drum) is capable of producing sparks or making certain parts red hot. Builders take care not to put inflammable materials near these, or at least to protect them by metal plates.

4. Piping.

The engines are carried either on the bogie or on brackets with indiarubber pads, which allows them to move slightly relatively to the body which carries the fuel oil pipes.

To prevent this connecting piping breaking under the influence of these movements, flexible piping is used more and more, following aircraft practice.

5. Fuel tanks.

Fuel tanks and more particularly petrol tanks, usually carried under the coach, should be protected against shocks likely to start leaks.

On the MICHELINE and BUGATTI railcars, the French Railways have adopted a system of protection similar to that of aircraft, which consists in fitting several layers of pure rubber and fabric tightly bound round the tank by a metal grill.

Certain railways use double-casing tanks with felt and poplar distance pieces between (Mozambique, MICHELINES).

In Italy very strong tanks in steel sheet, reinforced by metal rings, are preferred.

II. — Elimination of outside causes of fire.

All the measures we have just considered apply to causes due to the railcar itself; outside causes must not be overlooked.

1. Portable lights or train lamps.

Mobile lights are always electric (portable lamps with plug, lamps or torches with primary battery or accumulator).

When the driver of a railcar uses a bare-flame lamp, certain railway companies allot it a special place; others only allow the lamp to be lit outside the vehicle.

2. Filling the tanks.

When filling the tanks, the danger of fire is due to the vapours of the fuel from the reservoir, or to the latter overflowing. During filling, most railways do not allow smoking, approaching with a bare-flame lamp, or leaving the engines running. Certain railways furthermore endeavour to suppress the above two causes of fire by using a design which gives a tight connection between the flexible filling pipe and the outlet of the tank and shuts off the petrol when the reservoir is full (RELLUMIT system employed on the French main line railways).

3. Garaging the railcars.

The railways take care not to place the railcars near locomotives in steam, and not to run them over lines where freshly dropped cinders may be found.

Certain countries (Austria, Denmark) do not apply these precautions to diesel railcars.

III. — Precautions taken to prevent fire spreading.

Unfortunately all the above measures do not protect railcars against all fire

risks. When fire breaks out, it must be prevented from spreading as much as possible, so that the passengers can get out and the staff fight the fire with some chance of success.

1. Construction of non-combustible or fireproofed-materials.

Certain railway companies refuse to allow the use on railcars, of combustible materials not fireproofed.

Fireproofing of the wood is by impregnation (in France — Oxylene process — Incombustibilité), that of the fabric by soaking or pulverisation.

No precise rule seems to exist about the method of fireproofing to be adopted, and the conditions to be imposed for accepting these fireproofed materials. How efficacious the pulverisation process may prove to be, is still unknown.

Some railways are satisfied with protecting the wood by fireproof painting or by covering it with suitable fireproof materials (asbestos sheeting or plates with air spaces). It should be noted, on the other hand, that certain materials such as linoleum, imitation leather, etc... cannot be made satisfactorily fireproof.

2. Keeping fuel tanks away from the engines.

In order to avoid having too much fuel in store quite close to the engines, many builders locate the fuel tanks under the vehicle, whence they feed a small fuel tank. Such precautions are particularly necessary in the case of petrol engines, as it has been found that a diesel railcar could be wholly destroyed by fire without the gas oil contained in the tank catching fire.

By means of special devices, the passage of fuel to the feeding tanks or engines can be cut off immediately. For example, the Dutch railcars on which it is sufficient to operate two cocks placed together on one of the body sides, one of which cocks insulates the feed tank from the engine while the other cuts off the feed to the small fuel tank; the Italian and French railcars (Micheline or Bugatti) in which the action of a lever or switch cuts off the fuel from the engine.

3. Closing the electric circuits.

It should be noted that most of the builders have fitted a main switch for the electric circuits, handy to the driver.

4. Cleanliness.

All these precautions would be of little avail if the railcars were not kept absolutely clean.

They should be cleaned frequently so as to remove all deposits of dirty fuel and grease, which are apt to cause fires, especially on diesel railcars.

As a matter of fact gas oil is as inflammable as petrol when heated to 80° C. (176° F.), and while petrol evaporates quickly once spilled, gas oil speads everywhere, even to a considerable distance and does not evaporate. Furthermore, an incombustible material burns very easily when impregnated with gas oil.

On the other hand, the diesel engine is in itself much less clean than the petrol engine : this is due to the abovementioned properties of fuel oil and to constructional features (injectors).

B. — Fire extinguishing methods.

Railcars are as a rule fitted with extinguishers, either portable or fixed, the latter sometimes working automatically.

In addition, certain Administrations are providing in their railcars fire detectors with alarm signals, which arrangements can be very useful on railcars with several driving compartments (detectors fitted in Germany on petrol railcars).

The types of extinguishers used by the different Railway Administrations consulted are as follows :

a) Extinguishers with fire-proofing

liquid (Nasslöscher, Deutsche Reichsbahn);

b) Carbon-dioxide foam extinguishers (either ordinary foam for extinguishing fires of hydrocarbons without alcohol, or special foam for extinguishing hydrocarbon fires with alcohol) (French, Italian, Belgian and Finnish Railways);

c) Methyl bromide extinguishers (French and Hungarian Railways) or a mixture of similar products (mixture of ethyl bromide and brom-ethyl used in Germany);

d) Tetrachloride of carbon extinguishers (Austrian, Danish, French, German, Czechoslovak railways, etc...);

e) Carbon-dioxide snow extinguishers (French railways).

Mention may also be made of apparatus with powder, a few of which are used on the Hungarian railcars.

The extinguisher with carbonic foam is cheap, but takes up much room; the foam dirties much and is a good conductor for electricity.

It cannot be used on railcars fitted with electric transmission nor on those running over electrified lines.

Methyl bromide, carbon tetrachloride, and carbonic snow do not have these drawbacks.

Methyl bromide unfortunately is very dear and very volatile (boiling point : 4.5°), it necessitates special precautions in making the apparatus as regards tightness, which makes it still more expensive.

Its efficiency (2 to 5 times greater than that of carbon tetrachloride) is much less poisonous than the latter, which makes it often used, especially in the case of fixed apparatus of high capacity.

Tetrachloride, in spite of the two drawbacks mentioned above, has its advocates thanks to its very low price : it is therefore preferred for use in parts of the vehicle inaccessible to the passengers.

Carbonic snow has great extinguishing power but the room taken up and the weight of the carbonic dioxide cylinders and the complicated piping limit its use (Paris-Lyons-Mediterranean, France).

Different railway companies have confirmed the efficacy of extinguishers in their railcars, this efficacy having been demonstrated by fires put out in service or during tests of the apparatus.

Fire-extinguishing methods in railcar depots.

Besides the extinguishers fitted on the railcars, extinguishers of greater capacity are kept in the depots, either portable or on wheels (20, 50 to 100 litres = 4.4, 11 to 22 Br. gallons) in the case of foam extinguishers, 5 kgr. = 11 lb. in the case of the tetrachloride extinguishers, etc....) as well as sand with shovels.

Except in Hungary, no regulations as regards the number and capacity of extinguishers to be employed according to the number of rail motor coaches garaged appear to have been issued. This question cannot, moreover, be solved uniformly; the measures to be taken depend on the state of the surroundings and on the pre-existing local means of fighting fire (hydraulic pumps, etc...). On the Royal Hungarian State Railways two methyl bromide extinguishers of a capacity of 2 kgr. are used for every five rail motor coaches garaged.

* * *

To sum up, all the railways have attached great importance to the solution of the question of fire protection and have at their disposal to-day efficient extinguishers adapted to the various possible cases, and which have proved their value in service.

[621 .43)]

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION.

INQUIRY INTO QUESTIONS OF IMMEDIATE INTEREST.

(Decision taken by the Permanent Commission at its Meeting held on July 29th, 1933)

QUESTION I.

Rail motor cars from the point of view of their construction.

B. — Additional information and data brought up to date on the points already dealt with in part A-(Types of engines, Forms of transmissions, Running gear, Brakes) (1) — and : Body design — Lighting, heating and ventilation — Sundry apparatus and fire prevention — Speed characteristics and carrying capacity.

REPORT

(Countries outside Continental Europe),

by E. WANAMAKER,

Electrical Engineer, Chicago, Rock Island and Pacific Railway Company.

Test methods and measuring devices.

Most of those contacted advise that, due to the comparative newness of the art, methods of testing and checking have not been very well developed.

Engines are as a rule periodically checked for bearing, journal, cylinder wall, piston and piston ring wear. All important parts liable to fracture, such as connecting rods are whitewashed whenever engines are overhauled. Some roads change the connecting rod bolts on a mileage basis.

Gears are given close inspection, as a rule on a mileage basis.

Gages, thermometers, regulators, etc., are checked periodically.

Compression is checked whenever deemed necessary.

The fuel and lubricating systems are followed closely at all times, as is the cooling system.

The electrical equipment seems to require closer supervision than at first thought necessary, especially the insulation of the various parts of the equipment.

Those having the best success apply insulation tests periodically, preferring not to depend on visual inspections and such occasional checks and tests as might be made at the discretion of the maintainer.

Instruments are also checked periodically.

(1) See *Bulletin of the Railway Congress*, January 1935, p. 711.

Water boxes are used to check the efficiency and capacity of both engines and generators in connection with the use of necessary electric meters, fuel measuring devices, etc.

Much poor workmanship has been brought to light, as has quite some considerable use of improper material, by failure of windings etc., after a few years' service, such as should not have occurred. In many instances electrical connections were very poorly made, insulation was often improperly applied and in many cases the mechanical fastening or blocking of coils or windings was imperfectly done. It is recommended that manufacturers pay more attention to the design and workmanship of their products intended for use in rail motor trains, since the service of main-line high-speed trains is very hard and exacting. It is impossible to give any attention to the equipment while on the road and time in the terminal as a rule is limited since these expensive trains must be kept on the road if they are to effect economies.

It should also be remembered that the maintainers in the terminals do not have the opportunity of watching the equipment while it is operating under load on the line.

Traction motors should be better built mechanically and electrically, as their cost of maintenance will be excessive if they have to be disassembled in less than 200 000-mile periods.

Experience seems to indicate that the manufacturers of both diesel engines and electrical transmission equipment are not sufficiently alive to the service required of their products. Let it suffice to say that it is far more exacting than they seem to comprehend.

Another point that should be given more consideration is the desirability, if not necessity, of having one designing chief in charge of at least the power plant, transmission and control and its application to the car, train or locomotive involved, and he should be the one to set the performance specification as a whole.

Fuel pumps, lubricating oil pumps and water pumps should be periodically checked and tested for pressure and capacity.

Engines.

The *Continental Motors Corporation* has recently brought out a new type of 2-cycle radial diesel engine in 5-8, -10 cylinder sizes rated at 225, -360, -450 H.P. respectively at 900 r.p.m., all cylinders 6 1/2 in. bore by 7 1/2 in. stroke for rail motor trains and switching locomotives, as well as for power plants, industrial applications and marine service. These engines weigh 3 350 lb,. 3 650 lb. and 3 900 lb. respectively, all of them having an overall length of 40 5/16 inches and an overall diameter of 71 inches.

This engine has not yet been tested in rail service but the builders claim a fuel consumption of all engines of 0.43 lb. at 3/4 load, 0.45 lb. at full load (lb. per brake-horse-power/hour at 900 r.p.-m.), and that maximum fuel efficiency of 0.43 lb. per brake-horse-power/hour can be set for any horse-power output from 3/5 to 3/4 load.

The *Waukesha Motor Company, of Waukesha, Wisconsin,* are building a four-cycle, compression ignition engine of the airless injection type, with glow plug for cold weather starting, with 85 % of intake air compressed into a combustion chamber. This engine has a capacity of 100 H.P. and is similar to the *Comet* type engines used on many buses and trucks in England.

Some think that this engine could be well adapted in multiple to small industry switchers and railcars.

For truck service, they are building the 50-H.P. 4-cylinder Waukesha-Hesselman engine burning cheap diesel fuels; by solid injection with the aid of elec-

tric ignition, cylinder pressures are no higher than gasoline engine cylinder pressures.

The *Cummins Engine Company, of Columbus, Indiana,* are building 200-H.P. engines in which the fuel is preheated and gasified before injection through a single self adjusting valveless fuel pump. This engine has given very good account of itself in switchers and may soon be tested in railcar service.

The *Caterpillar Tractor Company, of Peoria, Illinois, The Hercules Motors Corporation of Canton, Ohio, The Atlas-Imperial Diesel Engine Company* and several other manufacturers are building small diesel engines of efficient design which they feel will enable them to eventually build engines suitable for small railcars and industrial switchers.

None of the railroads reporting have used superchargers as yet, so have no data on this subject, although several are studying this type of design. 2-cycle engines use scavenging blowers of Root, and Centrifugal 4-lb. type.

Some of the railroads reporting take down or remove and replace engines through an overhead or roof hatch, using an overhead crane to facilitate the operation. A few (in case of the smaller sizes of engines) remove them through the side or end of the car.

The majority of the roads reporting, especially so in the United States, much prefer to mount the engines in the body rather than on the bogie or truck, chiefly for the reason that they can be better protected from road shock and the weather, dirt, etc.; at the same time they are much more accessible for observation when in service and for maintenance and repair in the terminal.

Transmissions.

a) *Mechanical transmissions. — Distant control.*

From the reports received every indication is to the effect that the mechanical transmission has been generally unsatisfactory, (especially in the United States), in sizes or capacities greater than 150 H.P.; above this size the electric transmission has been used in practically all cases. The hydraulic transmission has apparently yet to be proven; several manufacturers are, however, endeavoring to develop a satisfactory hydraulic drive.

The Clark Equipment Company of Battle Creek, Michigan, have built and are experimenting with a transmission of this type which they call the « Clark Turbo-Drive ». In a general way it is somewhat similar to the Voith-Sinclair design. The oil, however, is passed through a cooling radiator on its return from the units to the storage tank, to be again circulated by the pump to the units as directed by the control valve.

The drive is a combination of two units, one a clutch unit, and the other a transmission unit (as ordinarily referred to in the mechanical drive). One of the units is a torque converter, the other functions as a hydraulic coupling or clutch.

The transmission drive shaft is connected to the driving axle of a truck through a combination of bevel gears, dog clutch, universal joints, spline shaft and propeller shaft.

For simplicity's sake, it might be said that the throttling of the engine, its power output and control, are practically similar to those of an engine using an electrical transmission. In this type of transmission, there is a cushion between the engine and the transmission and driving axle, which factor is similar to the cushioning effect obtained by the use of the electric transmission.

This cushioning effect is one of the vital factors of a successful transmission of a rail internal-combustion engine power unit.

The torque converter has a torque-multiplying ability equivalent to appro-

ximately a 4 to 1 gear ratio at starting, with automatic changes of speed, and torque multiplication up to approximately a 1 to 1 ratio, at which point the oil stream is diverted from the torque converter to the clutch or coupling member.

For practical design, construction and operation, it will be necessary to give full consideration to the factors of wear and reliability of that part of the transmission between the turbo-drive and the axle, since this has always been a difficult problem in rail equipment construction. It will also be necessary to give full consideration to the turbo-drive itself, since it is an innovation.

To successfully determine the net overall or commercial efficiency of this type of transmission for rail service, it would seem essential that several such equipments be built and tried out in the class of service involved, under suitable direction and operation.

The Clark Equipment Company is also working on the development of another form of transmission using gears in constant mesh, with hydraulic clutches, which retains the advantage of the cushioning effect inherent in the hydraulic clutches, affording a greater range in torque multiplication or gear reduction, at the expense of gears running constantly in mesh and a multiplicity of hydraulic clutches.

The hydraulic transmission is deserving of much more study than it has received, and it is to be hoped that not only will there be some satisfactory development along this line but that the manufacturers of electric transmissions will also exert themselves to improve their product, for while the electric is at the present time by far the most practical, as long as its efficiency is only 80 % at its best power output, and the losses may run as high as 40 to 50 % at times, and its weight is approximately 42 lb. per B.H.P. to transmit power from a diesel engine weighing only some 20 lb. per B.H.P. it would seem that there is room for improvement, especially when the cost and weight of the electric transmission is taken into consideration.

Experience in the United States has been such that mechanical transmissions except for small single power units not larger than 150 H.P., with preferrably four to six speeds, according to the service in which used, have not been successful.

b) *Electric transmissions.*

The electric transmissions reported are all of the direct-current type, practically all having a nominal voltage of 600, the generators ranging from 500 to 750 volts in detail design, with differentially-wound fields inter-related to an exciter and storage battery in such manner as to permit full engine utilization over a wide range of train speeds. It is this feature that has caused this type of transmission to be so universally used in practically all of the important or large motorization jobs.

The traction motors, today usually ventilated by forced air, are series-wound with a series, parallel, shunt control arrangement, direct or remote according to the requirements of the case in hand.

In many installations an auxiliary generator is necessary, driven either from the main engine shaft or by a separate engine, depending on the general layout of the equipment as a whole and the demands for current for other purposes than for electric traction.

The detail design of the remote control which is now being installed almost exclusively has proven to be most satisfactory when of the electro-pneumatic type. The flexibility and reliability of this system, its simplicity and the ease with which it can be maintained as well as its characteristics which make for

easy and smooth train operation, are the outstanding factors involved.

c) *Hydraulic transmissions.*

As stated above, the hydraulic transmission has been but little used, and to date it would seem that it cannot be classed as a standard of equipment. It is to be hoped, however, that future developments will extend its use to the point where it may be classed as one of the successful types of transmissions.

Bogies. Running gear.

The roads reporting on the latest train to be built have apparently found the four-wheeled truck to be entirely satisfactory in riding as well as other qualities, up to its load carrying capacity.

A detailed description of trucks for the « *Flying Yankee* » just completed by the *Edward G. Budd Manufacturing Company,* for the *Boston and Maine* (figs. 24 to 26, pp. 691 and 692) is given hereafter.

The four trucks are of conventional outside bearing type of construction, with various refinements and improvements in design to improve the riding qualities, reduce weight and render quieter operation. They weigh 54 100 lb., exclusive of the gears and motors of the power truck, and all have side frames and bolsters which were furnished by the General Steel Castings Corporation.

The power truck, carrying the weight of the power plant, has 36-inch wheels and hollow-bored axles. The trailer trucks are considerably lighter in construction and run on 30-inch wheels. All journals are fitted with Hyatt roller bearings. The bearings have solid rollers, with hardened one-piece cages and inner and outer races. The boxes are electric cast steel and all parts of the boxes and bearings can be completely and easily taken down with ordinary wrenches. The design retains the free lateral motion feature. Provision is made at the front of the box for visual inspection of lateral clearance and of the thrust members, without draining the oil or disturbing other parts.

Rubber inserts are used extensively in the trucks. There are inserts under the center plate, in both top and bottom equalizer spring seats, and between the ends of the equalizers and journal boxes. The bolster chafing plates are of hardened spring steel, but are insulated from the frame by vulcanized pads of sound-deadening rubber. At the sides of the center plate are strips of rubberized fabric belt material which take fore and aft thrusts and prevent metallic contact and transmission of sound. Rubber thimbles are also provided around the king pin and the center-plate bolts, the latter also including washers. Automotive brake lining is used wherever the members of the truck-brake rigging are likely to rub.

Holland helical-volute springs are used on the equalizers of all four trucks. These springs consist of the conventional helical outer coil with an inner volute spring in place of the inner helical coil. In order to dampen horizontal oscillations at high speed, Houdaille double-acting hydraulic railroad shock absorbers are installed between the bolster and truck transoms on all trucks. Not only is the dampening a benefit in eliminating uncomfortable side sway, but the double-acting features of the shock absorbers also prevent the bolster from striking through when the train enters a curve with a poor approach. The truck center-plate bearing, the bearing between the two articulation castings and also the truck side bearings are all faced with Oilite.

The trucks are equipped with Simplex unit cylinder clasp brakes. On the power truck the brakes are operated by a single cylinder mounted on the rear end frame. Each trailer truck is equip-

ped with two cylinders, one on each side, outside of the truck frames.

The distribution of the train weight is such that no two trucks are loaded alike. With the train ready for service the power truck is estimated to carry a weight at the rails of 94 000 lb.; the first trailer truck between the first and second car bodies, 47 700 lb.; the second trailer truck between the second and third car bodies, 42 800 lb.; and the third trailer truck at the rear end of the train, 29 100 lb.

The Union Pacific's M-10000, as built by the Pullman Company. — All of the four trucks are of the four-wheel type with cast-steel frames and rolled-steel wheels. The front or power truck has 36-inch wheels equipped with S.K.F. roller-bearing journals, placed outside of the wheels to provide space necessary for the two motors geared one to each axle, the armature being wound for a safe maximum speed of 110 m.p.h. The traction motors are G.E., type 716-b-1, 600-volt D.C. motors, rated at 300 H.P. They are force-ventilated, the air being cleaned before it is passed to the motors. The remaining three trucks have 33-inch rolled-steel wheels and inside-type roller-bearing journals to reduce the truck width and minimize air resistance.

There is no metallic contact between journal boxes and truck frames, these being separated by rubber. The rubber separation is paralleled by coil springs which take the static load. Extreme lateral motion of the trucks is damped by rubber bushings, and chafing plates, ordinarily used between the truck bolster and transom, have rubber packing to cushion the movement due to acceleration and deceleration. All coil springs are mounted on rubber pads.

Shocks absorbers on these trucks not only eliminated the uncomfortable side sway and lurch, but also effectively dampened what would otherwise be unpleasant vibrations, thus affording comfort to the passengers at all train speeds up to 120 miles per hour.

The « Zephyr » trains as built for the Burlington Railroad by the Edward G. Budd Manufacturing Company. — The four trucks are all of conventional outside-bearing type of construction. All have cast-steel frames and bolsters, furnished by the General Steel Castings Corporation. Their combined weight is 55 000 lb. without the motors and gears in the power truck. The power truck, in which are mounted the two traction motors, has 36-inch wheels. This is the front truck which carries the weight of the power plant. The trailer trucks, although of the same general type, are considerably lighter in construction and run on 30-inch wheels. All journals are fitted with Timken roller bearings. The axles are hollow-bored to reduce weight.

Of particular interest in the construction of the trucks is the extensive use of rubber insulation to prevent the transmission of sound and other high-frequency vibrations to the car bodies. There are inserts under the center plate, in both top and bottom equalizer spring seats, and between the ends of the equalizers and journal boxes. Rubber liners in the pedestals are faced with Oilite metal plates, vulcanized on, which serve as bearing surfaces for the faces and flanges of the boxes. The bolster pads, which insulate the bolster from the truck frame, are also faced with Oilite metal. In addition to the pad under the center plate, rubber thimbles are provided around the king pin and the center-plate bolts, the latter also including washers. A further precaution against unnecessary noise is the provision of automotive brake lining wherever the members of the truck brake rigging are likely to rub. To dampen vibrations of lower frequency, Holland helical-volute springs are used on the equalizers of all four trucks. These springs consist of the conventional helical outer coil with

an inner volute spring in place of the inner helical coil. The center plate bearing, the bearing between the articulation castings and side bearings are all faced with Oilite.

No two of the trucks carry the same load. With the train normally loaded the power truck is estimated to carry a weight at the rails of 98 000 lb.; the first trailer truck, between the first and second car bodies, 67 000 lb.; the second trailer truck, between the second and third car bodies, 45 000 lb., and the third trailer truck, at the rear end of the train, 30 000 lb. The nominal journal sizes are, respectively : Power truck, 6 in. by 11 in.; first trailer, 5 1/2 in. by 10 in.; second trailer, 5 in. by 9 in.; third trailer, 4 1/4 in. by 8 in.

Shock absorbers were effectively used on these trucks to overcome what would otherwise have been objectionable sway and vibration in the passenger compartments.

These trains are all of the articulated type and any tendency of the trucks to hunt was automatically reduced with the trucks designed as they were, and with the use of shock absorbers hunting has not been a problem.

As yet no roads have reported the use of 4-wheel trucks in conventional types of light-weight high-speed trains, that is trains made up of individual self-supported cars.

Those reporting as considering the use of such cars or having same under construction, advise that they anticipate the necessity of developing a new type of truck for these cars, and also the necessity of working out a new type of coupler with the trucks immediately under the ends of the cars for high-speed service, the cars probably having center instead of end entrances etc.; at the conventional speeds no trouble is anticipated.

The only tread change reported on 4-wheel trucks was in the case of suburban electric multiple-unit trains where the flatter treads improved the riding qualities but no shock absorbers were used.

Brakes.

Brake systems in the United States have as yet been limited to brake shoes functioning against the tires or wheel treads and are therefore unable to supply any data relatively to electro-magnetic brakes, slippers, brake drums or blocks, bands, linings, etc. The clasp brake with shoes of various compositions but all applied in conformity with well known standards are universally used.

Recent tests and operation of the Union Pacific Railroad Company's six-car, 210-ton (including everything but pay load), streamlined train, powered with a Winton 900-H.P. diesel engine, proved beyond doubt the necessity for a thoroughly modern brake system.

This train attained a speed of 120 miles per hour for a distance of 3 miles, 108 miles per hour for 18 miles and 85 miles per hour for the 506 miles between Cheyenne, Wyoming, and Omaha, Nebraska, all of which are records for rail speed. The balanced speed of this six-car train is approximately 95 miles per hour.

Two nine-car trains of similar design, each powered with a Winton 1200-H.P. diesel engine are now being built in Pullman plant at Chicago for operation, one between Chicago and Los Angeles, the other between Chicago and San Francisco. The six-car train is assigned to the run between Chicago and Portland, Oregon, the distance in each case being approximately 2 300 miles, to be covered in less than forty hours.

The topography of the country traversed is quite varied, ranging as it does from flat prairie through ascending uplands to the heavy grades and sharp curves of the rugged Rocky Mountains, in all of which are to be encountered all varieties of weather conditions.

The arresting of 120 000 000 ft.-lb. of energy on the six-car train at 90 miles per hour in the space of forty seconds, or about one half mile with safety and comfort to the passengers under emergency as well as under regular service condition, was a difficult feat of accomplishment. However, the design as originally worked out and developed by the New York Air Brake Company for the Union Pacific's M-10000, the three-car aluminium, light-weight articulated streamlined, 600-H.P. train, (the first of this type ever built), has proven entirely satisfactory and is now being built into the two 9-car 1 200-H.P. trains now under construction.

In view of the importance of this factor, (the smooth, quick and safe stopping of high-speed trains), am quoting in part from the manufacturer's instruction book relative to this brake equipment as follows.

The modern high-speed unit trains had their inception with the Union Pacific, three-unit, articulated, streamlined train which was successfully introduced in February, 1934. These trains represent a radical departure from conventional passenger equipment. The streamlined contour, light-weight construction, articulation of body units, all have resulted in unit light-weight trains capable of economically maintaining a 50 % higher schedule speed than present passenger trains. The many new and improved operating and constructional features of these modern high-speed trains render the standard conventional passenger brake equipment entirely unsuitable for this type of service.

High speeds have necessitated a brake equipment much faster in response, and one which will guarantee higher average retarding forces throughout the entire stop, in order that the stopping distance of these modern high-speed trains from high-schedule speeds, will not be appreciably greater than those obtaining with conventional steam trains, from the ordinary speeds at which they operate.

Light-weight construction has necessitated a departure from former air brake design in order to effect a decided reduction in brake equipment weight.

Streamlining has necessitated reducing the overall sizes of individual devices in order to meet installation limitations. Also inclosing the equipment within the car body has increased the necessity of silent operation.

Articulation of body units, together with the required increase in average retarding forces, have necessitated the provision for automatically reducing this force as the speed decreases in order to prevent wheel damage at the lower speeds.

Recognizing, in addition to the above, that considerations of safety, comfort of passengers, and economy of time under modern severe traffic requirements demands a brake equipment possessing many characteristics not available in conventional passenger car brake equipments, and with a view towards providing extremely rapid deceleration rates, a decided reduction in brake equipment weight, and simplicity of operation, the New York Air Brake Company developed and introduced on the first Union Pacific train its *Decelerometer controlled, electro-pneumatic brake equipment, schedule « DCE »*.

This equipment, as applied to the first Union Pacific train and as shown in figures 1, 2 and 3, is arranged for single-end operation and is particularly adapted for installation on *unit trains* consisting of any practical number of articulated units.

The operating and constructional characteristics of the equipment are as follows :

1. Simplicity and flexibility for normal service and emergency braking is insured by the straight-air brake system, employing relay valves which admit and

release air from the brake cylinders in response to the admission and release of air from a control line extending throughout the train.

2. Positive response in the event of a failure of the straight-air system to function properly, is insured by the automatic emergency system, comprising a supervisory line running throughout the train, small vent valves and conductor's valves connected to this line, and a brake application valve which operates upon sudden reductions in supervisory line pressure to produce an emergency application.

3. Extremely rapid and simultaneous response of each relay valve during normal brake applications and releases is accomplished by the electro-pneumatic control of the admission of air to, and the release of air from, the control line, with provision for proper operation in the event of failure of the electric circuit by paralleling all the electro-pneumatic functions by purely pneumatic operation.

4. Rapid development and exhaust of brake-cylinder pressure is accomplished by providing a relay valve and an air supply reservoir for the brake cylinders of each truck. During the application cycle, the air admitted locally to each pair of brake cylinders is supplied through the relay valve from the local reservoir which is continuously charged from the supervisory line. During the release cycle, the exhaust of brake-cylinder air occurs locally through each relay valve.

5. A high, uniform retarding force, procured by the employment of high braking ratios, is made practical because of the governing action of a decelerometer, a device which operates automatically to adjust the braking force to provide a predetermined rate of deceleration of the train as a unit. Thus, the advantage of using a high braking force when the speed is high and the coefficient of friction low, can be successfully utilized, because as the speed decreases and the coefficient of friction increases the decelerometer operates to reduce, and thereafter maintain, the retarding force at a predetermined uniform value below that which might cause wheel damage.

6. Being governed by the deceleration rate, the retarding action of the brakes is the same for any empty and load condition provided, of course, that excessively high unit shoe pressures do not prevent obtaining the desired deceleration rate on the fully loaded train at the high speeds.

7. Comfort of the passengers during all decelerometer-controlled stops is insured by the provision in the decelerometer for automatically changing its deceleration rate adjustment to a low value just previous to stopping, in order to eliminate a noticeable jolt at the end of the stop, which would certainly result were there a sudden change from a comparatively high deceleration rate to a state of rest.

8. During emergency applications not under prompt release control of the operator, the emergency brake-cylinder pressure development is controlled in two stages; a rapid inshot to 60 pounds followed by a slower rate of development to the maximum required. This insures positive assumption of control by the decelerometer during such applications, irrespective of initial speed.

9. Proper provision is made for limiting the braking force to a value which will prevent wheel damage irrespective of speed, during such brake applications not under control of the decelerometer.

10. Protection in the event of the operator becoming incapacitated is provided by the safety control feature equipment which operates to produce an emergency brake application and close the engine throttle to an idling

Figs. 1 to 3. — **Piping arrangement of Union Pacific Railroad articulated trains.**

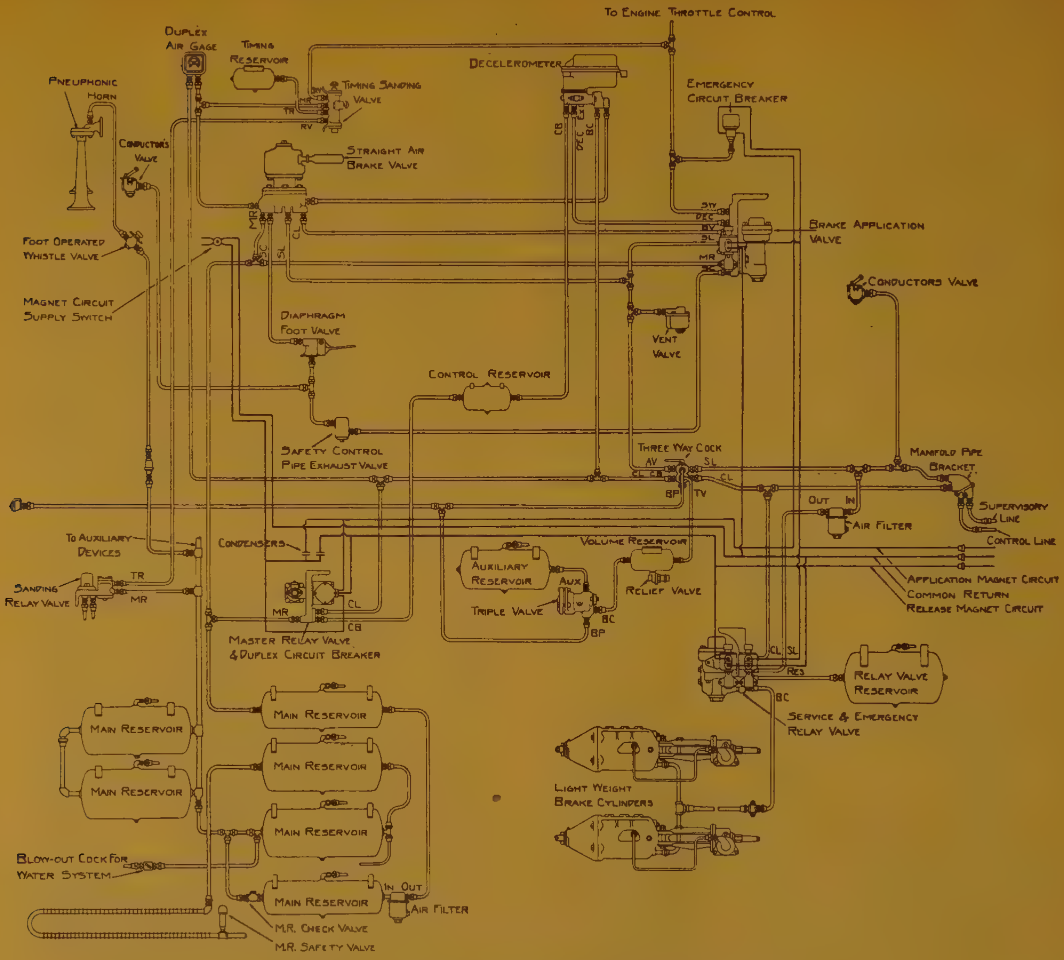


Fig. 1. — Piping arrangement of motor car.

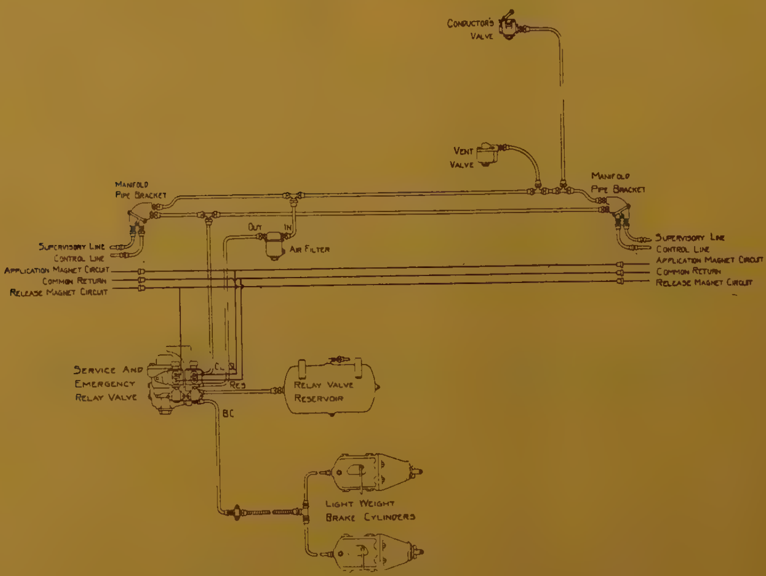


Fig. 2. — Piping arrangement of intermediate trailer car.

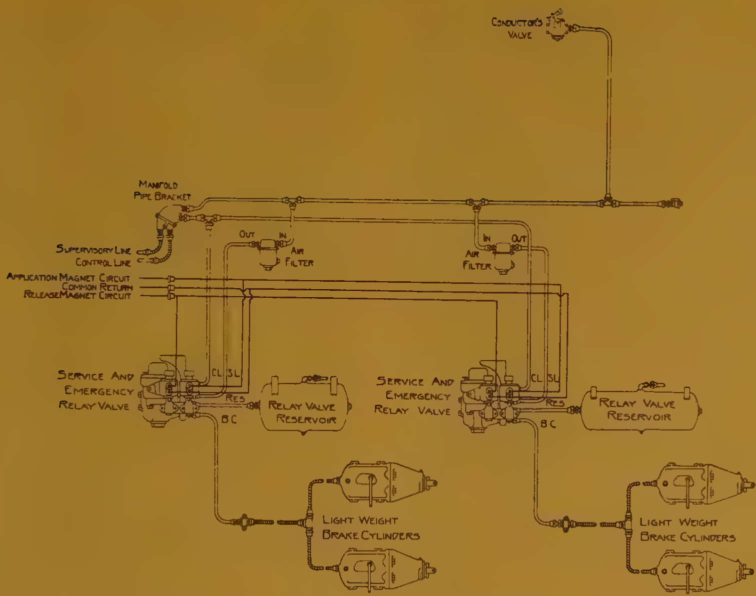


Fig. 3. — Piping arrangement of buffet car.

speed, should the operator for any reason remove his hand from the brake valve handle without first depressing the foot valve pedal.

11. Protection in the event of ruptured piping, or dissipation of main reservoir pressure below a predetermined value is provided by the automatic action of the relay valves, which operate to produce an automatic emergency application whenever the pressure in the supervisory line falls below a certain value without an attendant increase in control-line pressure. This feature, during initial charging, prevents moving the train until a safe main reservoir pressure has been obtained.

12. Emergency operation of the brakes by trainmen other than the operator is provided by conductor's valves located at convenient points throughout the train.

13. Proper operation of the train brakes when hauling the train « dead » is provided by an auxiliary automatic system which operates in response to variations in brake pipe pressure initiated by the automatic brake valve of a standard steam road locomotive to admit or release air from the control line. The equipment is arranged for hauling the train « dead » by positioning only one three-way cock.

14. Light-weight construction of all parts of the equipment is obtained by the extensive use of special aluminium alloy castings and by careful design to reduce the overall size to a practical minimum.

15. Efficient operation over long service periods, and low operating and maintenance costs are assured by the employment of the most modern and proved principles of design.

Parts of the equipment.

The following is a list of parts, with a brief description of each part, as fur-

nished for the first Union Pacific train. This first train comprises a combination motor, baggage and mail car, a day coach, and a buffet car. The equipment readily lends itself to the inclusion of a fourth unit of similar type. This fourth unit will include the equipment shown on the piping diagram of the intermediate trailer car, figure 2.

1. Two 25-cu. foot *motor driven air compressors* with suitable intake strainers which furnish the compressed air for the air brake system and auxiliary devices.

2. A *combined fuse and switch* in the line from the engine to the governor and air compressor, protecting the latter from excessive flow of current and enabling the current supply to the compressor to be entirely cut off when desired.

3. A *compressor governor*, which automatically controls the operation of the air compressor between predetermined maximum and minimum main reservoir pressures.

4. A *main reservoir safety valve*, which prevents the development of excessive main reservoir pressure in case the governor for any reason fails to stop the compressor.

5. Six *main reservoirs*, to which the compressed air is delivered, and in which it is cooled and stored for use in the air brake and auxiliary equipment.

6. A *main reservoir check valve*, located between the fourth and fifth main reservoirs, which prevents the auxiliary devices such as pneuphonic horns, sanders, etc., drawing air from the air brake equipment main reservoirs, thereby insuring adequate operating main reservoir volume for the air brake equipment.

7. *One 3/4-inch × 3/4 inch air filter*, complete with a removable filter insert, located between the fifth and sixth main reservoirs for filtering all the main reservoir air flowing to the air brake equipment.

8. One *1/2-inch × 1/2-inch* air filter, complete with a removable filter insert, located in the supervisory line branch leading to each service and emergency relay valve pipe bracket, for an additional filtration of the air flowing to each relay valve reservoir.

9. A *duplex air gage*, which indicates the main reservoir and control line pressures. The black hand shows main reservoir pressure at all times, and the red hand shows control line pressure at all times except when equipment is arranged for hauling the train « dead ».

10. A *brake valve*, which (*a*) admits air to and from the control reservoir during normal service or emergency applications and releases of the brakes, (*b*) exhausts air from the safety control pipe to initiate a safety control feature emergency application, (*c*) provides a constant maximum adjustment of the decelerometer when the brake valve handle is in *emergency* position, and (*d*) admits air to the supervisory line when brake valve handle is in *release* position to release the brakes following a brake application valve initiated emergency.

11. A *control reservoir*, which is connected to the duplex circuit breaker and master relay valve to provide a constant measuring volume for obtaining a substantially uniform rate of brake application, and release, irrespective of train length.

12. A *duplex circuit breaker*, which operates in response to the difference of air pressures in the control reservoir and control line, to provide proper operation of the application, release and bypass magnet valves during electro-pneumatic brake applications and releases.

13. A *master relay valve* which, upon failure of the electric circuit, parallels pneumatically the function of the duplex

circuit breaker by controlling the flow of air to or from the control line in response to the differential of air pressures in the control reservoir and the control line.

14. One *application magnet valve* attached to each service and emergency relay valve pipe bracket which, when energized, opens to admit relay valve reservoir air to the control line locally at a rate regulated to provide a rapid and uniform development of control-line pressure throughout the train.

15. One *release magnet valve* attached to each service and emergency relay-valve pipe bracket which, when energized, opens to exhaust control line air to the atmosphere locally, at a rate regulated to provide a rapid and uniform release of control-line pressure throughout the train.

16. One *service and emergency relay valve* for each truck which operates (*a*) to allow charging of the relay valve reservoir from the supervisory line at all times but prevents reverse flow; (*b*) to control the admission and release of brake cylinder air locally in response to the admission and release of air in the control line, thereby providing a prompt brake action at each truck; (*c*) to provide an automatic brake application in the event of the main reservoir pressure falling to a dangerously low value; and (*d*) to provide an automatic brake application in response to a reduction in supervisory line pressure, should the control reservoir or control line piping be broken.

17. One *relay valve reservoir* for each service and emergency relay valve, in which air at substantially main reservoir pressure is stored locally for admission to the brake cylinders during all types of brake applications.

18. Two *brake cylinders* per truck, with piston and rod so connected through the brake levers and rods to the brake shoes that when the piston is forced outward by air pressure, this force is transmitted through the rods and levers to the brake shoes, forcing them against the wheels.

19. One *automatic slack adjuster* for each brake cylinder, which maintains a predetermined brake cylinder piston travel, and, consequently, a substantially uniform brake cylinder pressure.

20. A *decelerometer* which, (1) with the brake valve handle in *emergency* position automatically adjusts the braking force to maintain substantially uniform a pre-determined maximum rate of retardation throughout the entire stop; (2) with brake valve handle in *lap* ou *service* positions, automatically changes its adjustment to lower the retardation rate just previous to the final stop to bring the train to rest with only enough brake cylinder pressure to keep the train from moving; and (3) with the brake valve handle in *release* position permits a release of the brakes irrespective of the position of the balanced control valve.

21. A *brake application valve* which operates in response to a sudden reduction in supervisory line pressure to : (*a*) produce an emergency brake applic .tion which is under control of the decelerometer for the major portion of the stop; (*b*) condition the sanding apparatus for sanding the rail a limited time; (*c*) cause a movement of the engine throttle to idling speed; (*d*) close off communication between the main reservoir and supervisory line and between the control reservoir and the brake valve; and (*e*) open the application magnet circuit.

22. A *safety control pipe exhaust valve*, which operates during a safety control feature emergency application, in response to a sudden pressure reduction in the safety control pipe, to open a large capacity vent on the supervisory line, and thus insure a prompt movement of the brake application valve to applied position.

23. A *diaphragm foot valve* located in the safety control pipe between the brake valve pilot valve and the safety control pipe exhaust valve, which when the foot pedal is depressed, enables the operator to remove his hand from the brake valve handle without causing a safety control feature emergency application of the brakes.

24. One *vent valve* on each unit of the train except the rear unit, which operates in response to a sudden reduction in supervisory line pressure to provide a prompt and complete venting of the air in the supervisory line regardless of its length, and thus insure positive operation of the brake application valve during safety control feature, broken supervisory line, or conductor's valve emergency applications.

25. A *by-pass magnet valve,* attached to the brake application valve pipe bracket, which when energized opens a large-capacity port between the main reservoir supply and the supervisory line.

26. *A dead man's control by-pass valve,* which operates during all brake application valve initiated emergencies to automatically reduce the engine throttle to an idling position.

27. An *emergency circuit breaker,* which operates during all brake application valve initiated emergency applications, to open the application magnet circuit in order to prevent operation of the by-pass and service magnet valves.

28. One *conductor's valve* on each unit of the train, and one in the operator's cab, which operate to produce an emergency rate of supervisory line pressure reduction, and thus provide means for enabling trainmen other than the operator to apply the brakes if necessary.

29. A two-position *three-way cock,* which in normal position connects the control and supervisory lines to the cab equipment for normal train operation, and in its other position isolates the cab equipment and connects the control and supervisory lines to the special automatic equipment employed when hauling train « dead ».

30. A *plain triple valve,* which operates in « dead » train service to control the flow of air from the supervisory line to the auxiliary reservoir for charging the latter; from the auxiliary reservoir to the control line for applying the train brakes; and from the control line to the atmosphere for releasing the train brakes.

31. An *auxiliary reservoir,* in which the air is stored for actuating the train brakes in « dead » train service.

32. A *control line volume reservoir,* which is connected to the control line when equipment is arranged for hauling train « dead », for the purpose of stabilizing the action of the train brakes in this type of service.

33. A *relief valve,* which in « dead » train service limits the control line pressure to a value which will produce a train braking ratio substantially equal to the standard locomotive braking ratio.

34. A *pneuphonic horn* operated from a main reservoir supply for providing an audible warning device.

35. A *foot-operated whistle valve* for operating the pneuphonic horn.

36. A *hair strainer located* in the main reservoir supply line to the whistle valve and pneuphonic horn for protecting these devices from foreign substance.

37. A *timing sanding valve* which operates to control the flow of air from the main reservoir to the timing reservoir, for charging the latter; from the main reservoir to the sanding relay valve during instantaneous sanding manipulations; and from the timing reservoir to the standing relay valve during automatic sanding manipulations.

38. A *sanding relay valve* which operates to admit air from the main reservoir : (*a*) to the sanding connection of the sand traps for sanding the rails, and (*b*) momentarily to the cleaning connection of the sand traps for providing a limited high-capacity air jet to insure instantaneous sand delivery.

39. A *timing reservoir* for timing the sanding interval during automatic sanding operations.

40. Various *pipe fittings, armored hose connections, hose angle fittings,* and *bracket couplings,* the location and uses of which will be readily understood from the piping diagram of the equipment.

Two main pipe lines are used with the « DCE » equipment, the *control line* and the *supervisory line,* both lines being continuous throughout the train, and employing flexible armored hose for connections between the articulated units of the train.

The admission of air to, and the release of air from, the control line governs the operation of the service and emergency relay valves when making normal applications and releases.

The supervisory line, normally charged at all times to main reservoir pressure, forms the communication by which the relay valve reservoirs are kept charged to main reservoir pressure. Through this line safety control feature, conductor's valve and broken pipe emergency applications are propagated. This pipe extends the entire length of the train, and is connected to the automatic system of a standard locomotive when hauling the train dead.

Two electric control circuits, the application magnet circuit and the release magnet circuit, with a common return are used to provide electric control of the magnet valve portions of the service and emergency relay valves by the duplex circuit breaker. One 0.25 mfd. condenser is used in each circuit to prevent excessive arcing at the contact points of the circuit breaker.

As shown on the motor car piping diagram, figure 1, a diaphragm cock is placed in a branch main reservoir pipe which leads to the water system. This cock is for the purpose of blowing out the water pipes with main reservoir air at desired intervals.

While a pressure-reducing valve was not employed on the first Union Pacific train, for providing a pre-determined operating pressure somewhat lower than the main reservoir pressure, the equipment readily lends itself to the inclusion of a feed valve of the usual form. When so used it is interposed between the first and second groups of main reservoirs.

Admittedly, the lighter the train, the easier the problem of heat dissipation, but we cannot afford to lose sight of the adhesion factor such as obtains at high train speeds, nor the relationship existing between brake shoes and wheel treads or brake drums.

In the event that high-speed trains become widely used, it is probable that rail brakes, possibly electro-magnetic, as well as electro-pneumatic with automatic friction control accessories, will be developed. At any rate, we have the satisfaction of knowing that today we have already tremendously improved our braking distances, and at the same time effected a great improvement as regards the comfort factor with increased safety an automatic result.

*
* *

Railcars in the different countries.

a) United States.

Table I shows the articulated motor trains and railcars now being built or recently completed for service in the United States.

TABLE I. — **Orders for articulated motor trains and rail motor cars now being built or very recently completed for service in the United States.**

RAILROAD.	Number of car units each.	Type of power plant.	Horse-power.	Seating capacity.	Length of baggage compartment.	Weight, lb.	Builder.
Boston & Maine	1AC	3 Oil-elect.	600	144	10′ 8″	207 619	Winton — General Electric — Budd.
	1	1 Oil-elect.	800	...	35′ 11″	200 000	Ing.-Rand—General Electric—St. L. Car.
	1	1 Oil-elect.	800	...	35′ 11″	200 000	Westinghouse—St. L. Car.
Chicago, Burlington Quincy	2	3 Oil-elect.	600	88	28′ 0″	210 000	Winton — General Electric — Budd.
	1 (*)	Coach body.	...	40	...	...	Budd.
Gulf, Mobile & Northern	2	4 Oil-elect.	660	...	31′ 8½″	168 000	McI. & Sey.—West-American.
Illinois Central	1	6 Oil-elect.	1 200	148	21′ 0″	493 000	Winton — General Electric — Pullman.
New York, New Haven & Hartford	1AC	3 Oil-elect.	800	164	...	250 000	Westinghouse—Goodyear.
Norfolk Southern.	2	2 Gasoline.	168	53	12′ 11″	41 000	Hall Scott—Brill.
Union Pacific	2 (**)	10 Oil-elect.	1 200	104	54′ 5″	...	Winton — General Electric — Pullman.

(*) Stainless steel, for addition to an articulated train.
(**) 8 of the 20 cars in these 2 trains are being built for the Pullman Company.

The American Car and Foundry Company are building two diesel-electric streamlined 4-car semi-light weight trains for the Gulf Mobile and Northern, powered with 660-H.P., McIntosh and Seymour engines, and Westinghouse electrical equipment.

The Pullman Company is building a diesel-electric streamlined, 6-car articulated train of Corten steel, for the Illinois Central Railroad, powered with a 1 200-H.P. Winton engine, and General Electric electrical equipment, to operate between Chicago and St. Louis.

The Brill Company is building two 2-car light-weight trains for the Norfolk Southern, powered with 168-H.P. Hall Scott engines, to be used in what might be called local territory service.

The St. Louis and Southwestern Railroad (Cotton Belt) has, for more than a year, been successfully operating highway buses, converted to light railcars. This transfer of equipment from highway to rail had its inception in 1932, when a Yellow-W coach was converted into a rail inspection car by the application of a driving mechanism manufactured by the Four-Wheel Drive Company, and four-wheel drive axles, the wheel design having been evolved by Cotton Belt engineers. The operation of this car proved quite successful, and in 1933 two Yellow Z 2-50 coaches were similarly converted for regular passenger service.

Late in 1933, these coaches were put in daily operation between Texarkana and Pine Bluff, a distance of 151.7 miles. Their on-time performance throughout the year has been unusually good. They have an available speed of 64 m.p.h. in reverse.

Prior to the operation of these rail-buses, the Cotton Belt operated a through train in each direction daily between Dallas and St. Louis. Shortly after the rail-buses began their runs, this train was made an overnight run between Dallas-Shreveport and Memphis. At the same time, an overnight train was scheduled between Pine Bluff and St. Louis. Pine Bluff and its vicinity had previously been served only by the through Dallas-St Louis train of the Cotton Belt, which passed through these cities at inconvenient early morning hours, and did not arrive in St. Louis until late in the day.

Type of equipment converted. — The motor coaches which were converted into rail-buses had each registered 350 000 miles in highway service on regular bus routes of the Southwestern Transportation Company, before that company sold its coach interests to the Southwestern Greyhound Lines. These two coaches have since completed a total of 80 000 miles each of service on railway tracks. So far as their mechanical operation is concerned, the number of road failures on the rails has been materially less than when they were in highway service.

The rail-buses have a capacity of 27 passengers and weigh 25 800 lb. empty. This is about 2 500 lb. heavier than when they were in road service, accounted for by the installation of lavatories, pilots, sand boxes, etc. The water tanks for the lavatories and toilets have also been piped to the radiators and serve as auxiliary water tanks for the purpose, while an auxiliary oil supply is also carried.

Comparative costs. — Each rail-bus has a capacity of 134 gallons of gasoline, which is ample for a round trip, the buses being supplied with gasoline only at the Pine Bluff end of the runs, where tank facilities are more readily available than at Texarkana. They are mechanically inspected and maintained at Texarkana by the bus and truck mechanics of the Southwestern Company. They average five miles per gallon of gasoline and despite the increase of 1 1/4 tons in weight, their gasoline consumption is the same as when they were in equivalent highway service.

The number of stops and of reductions in speed is, of course, a predominating factor in fuel consumption on either highways or on rails. In view of this, an approximately equivalent gasoline consumption is remarkable, since the rail-buses make as many or more station stops, and since the railway crosses many more highways at grade between these two points than the highway crosses railways, making more speed reductions necessary in rail operation.

As previously stated, these units are being operated at a cost from two to three cents a mile cheaper than was anticipated, the figure of savings being based on a year's careful cost studies.

Mechanical details. — The operation of these rail-buses brought out a number of interesting comparisons, particularly as to braking. The coaches in their original form were, of course, equipped with automotive-type air brakes, and, in highway operation a brake chamber pressure of 75 lb. was maintained and found to be satisfactory.

Because of the adhesion factor, this pressure was arbitrarily reduced to 30 lb. before the coaches were put on the rails. This, however, proved unsatisfactory under actual operating conditions because of excessively severe braking action. The brake leverage was then reduced and the air pressure was established at 17 lb. As far as actual braking was concerned, this pressure was satisfactory enough, but difficulties were encountered in keeping the pressure at exactly 17 lb. At such low pressure, even as much as one pound variation one way or the other represented a large percentage of increase or decrease, as the case might be, in the braking effect.

This braking problem was finally solved, however, when the Cotton Belt purchased brake lining with as low a co-efficient of friction as possible. After this was applied, the brake chamber pressure was increased to 50 lb., and no further difficulties have been encountered.

The buses were operated for a time with the ordinary highway spring system. This, however, proved unsatisfactory for operation on metal wheels and rails. A new spring suspension, adapted to the prevailing conditions, was designed by Cotton Belt engineers, and, since its application, rough riding has been eliminated.

b) Other countries.

None of the railroads in the other countries reporting, indicate that they have any new equipment under construction at this time, except the Great Western Railway, of England, who report as shown in table II.

TABLE II.

Car number.	Horse-power.	Number of engines.	Number of speed gear boxes.	Type of body.	Drawing.
1	130	1	1	Suburban passenger.	Fig. 4.
2	260	1	»	Buffet car.	Fig. 5.
3	»	»	»	» »	Fig. 5.
4	»	»	»	» »	Fig. 5.
5	»	»	»	Not yet built.	None available.
6	»	»	»	» » »	Do.
7	»	»	2	» » »	Do.

Fig. 4.
Railcar No. 1.

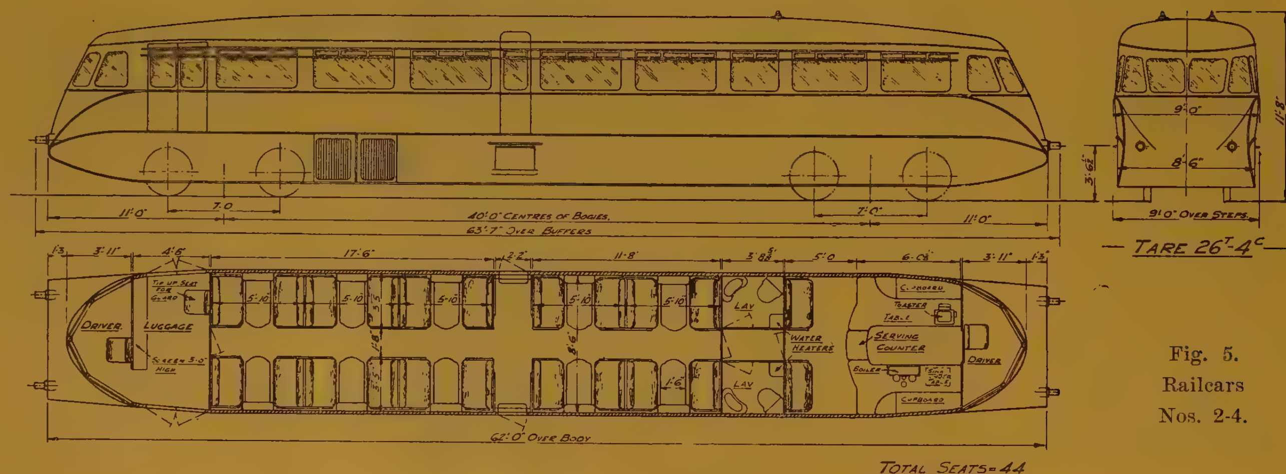


Fig. 5.
Railcars
Nos. 2-4.

Fig. 4 and 5. — Diesel railcars, Great Western Railway (Gt. Bn.).

Diesel-electric articulated streamlined light-weight high-speed trains.

There are now in operation, in the United States, four trains of the « Zephyr » type, with five more under construction, making a total of nine.

One of these trains is being built not with the idea of attracting more traffic to the run on which it is to be used, but to secure a lower cost of operation than is deemed possible with the steam train which is to be replaced.

These nine trains will all be used on comparatively short runs, that is, daylight services, meaning on runs not requiring sleeping accomodation.

In addition to these articulated « Zephyr » type trains, there is now in service a Union Pacific articulated « Streamliner » train in daylight service, making a total of ten articulated trains without

Fig. 6. — General view of Burlington « Zephyr » train.

sleeping accomodation now in service or under construction. There are also two Union Pacific articulated « Streamliner » trains with sleeping accomodation now ready for long-haul service, with another similar train being built, making a total of thirteen diesel-electric articulated streamlined light-weight, high-speed trains, either in service or being built in the United States at this time, with prospects for many more in the not far distant future.

The « Comet ».

The Goodyear-Zeppelin Corporation is at this time testing the three-car, high-speed, light-weight (aluminum alloy), streamlined, double-ended articulated diesel-electric train (the *Comet*) just completed for the New York, New Haven and Hartford Railroad.

The train was designed for operation between Providence, Rhode Island and Boston, Massachusetts, two cities in

Fig. 7. — Burlington « Zephyr » train. — Car body construction.

a densily populated section of New England, 43.8 miles apart, with a proposed schedule of 44 minutes including two stops and speed limitations. The top speed of the train for this run was limited to 90 m.p.h., requiring rapid acceleration. Due to the rather short distance and lack of facilities to turn the 207 foot long train on both ends of the run, the train was designed as a double end train with power plants and controls on both ends.

Two 400-H.P. Westinghouse diesel engines are directly coupled to two railway-type generators and integral exciters, and two traction motors of 200 H.P. each are located in the two end trucks. In normal operation both diesel engines are used simultaneously, but the train can also be operated from either end with only one engine.

The acceleration of the train is such that its speed will be about 60 m.p.h. within two minutes.

The train is provided with comfortable walk-over type chairs and will seat 160 passengers.

While light weight was considered of great importance for this train in order to obtain the required acceleration, strength and rigidity greatly influencing maintenance costs and life were considered of equal importance. Maximum strength combined with low weight was therefore the keynote of the design; and a special type car body was designed to meet this requirement. This car body design offers exceptional rigidity and also a high factor of safety and energy absorbing qualities in case of collision.

The floor of the cars is extremely low (32″ above top of rail) and but two steps are required to enter or leave the

Fig. 8. — Burlington « Zephyr » train. — Car body construction.

train. These steps on both sides of centrally located vestibules are air-operated and in closed position; steps and doors retain an unbroken smooth outside surface with the rest of the train. This smooth outside with well rounded corners, the covered bottom in which the trucks are located and the good streamlined shape of the ends reduce the air-resistance of the train to a minimum.

Due to the low floor height, it was not necessary to reduce the cross-section of the passenger compartments in order to minimize air-resistance and, therefore,

a clear standing height of 7 ft. 10 in. in the center, and 6 ft. 8 in. doors could be provided. The width of 9 ft. 4 in. is also above normal and leaves a 26-inch aisle with two 43-inch double seats on both sides. The center of gravity of the train is about 54 inches above the rail top, and almost the same when loaded as when empty.

A new type of truck suspension has been designed to take care of this low center of gravity and to provide easy riding at higher speeds. Elliptic springs have been eliminated and coil springs with hydraulic dampening provide the cushioning. Rolling of the car body has been almost entirely eliminated, providing greater stability, and all oscillations are of low frequency and well dampened out, which is necessary for passenger comfort.

Scientific heat- and sound insulation is applied throughout the train. All passenger compartments are indirectly lighted and a thermostatically-controlled air-conditioning system provides ventilation and heating or cooling, as required by weather conditions. The interior design is purely functional, with emphasis upon simplicity and the color scheme has been chosen to create comfort and warmth as well as cheerfulness. A limited number of tan colors, ranging from the light ivory tone of the ceiling to the deep rich copper color of the seat covers, combined with metal moldings and other hardware of natural silver satin finish, has been selected to create an æsthetic appearance and to let the various materials express their own beauty. Ornaments have been strictly avoided.

Various safety features are incorporated in the design. An efficient air brake system with deceleration control stops the train from its higher speed in a shorter distance than present train equipment can be stopped from its lower speed. The train cannot start before the air reservoir pressure is up to nor-

Fig. 9. — General view of six-car train, Union Pacific Railroad.

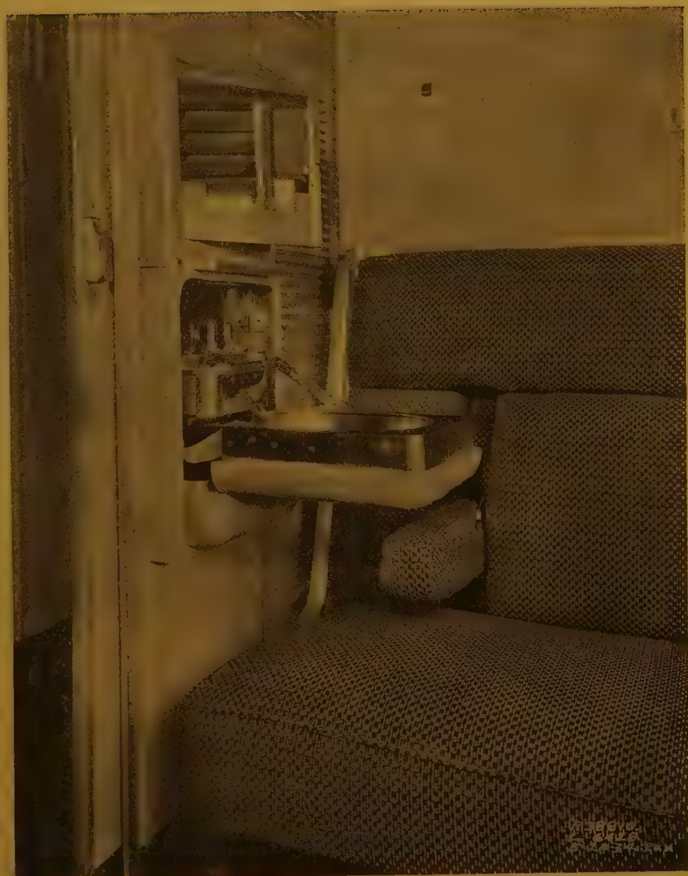


Fig. 10. — Union Pacific train.
Inside of Pullman section showing folding wash basin, shaving mirror and folding arm rest.

Fig. 11. — Union Pacific train.
Interior view of passageway through articulation between cars.

Fig. 12. — Union Pacific train.
Vestibule showing rolling steps, door, etc.

Fig. 13. — Union Pacific train.
Interior of rear buffet coach looking towards rear buffet.
Air conditioning duct and indirect lighting trough overhead.

mal, and in case the engineer should loose conciousness, the train will stop automatically. The train cannot start while the doors are open and the steps cannot be closed while somebody is touching them. An air brake application automatically idles the engines and if the lubrication system does not function properly, the engine will trip itself.

Car body design. — The « Comet » is

Fig. 14. — Union Pacific train. View of car framing from inside.

built as a tube with flat sides and well arched roof and bottom. In place of the center sill and other longitudinal framing of the conventional train, four longitudinal tubular members run the entire length of each car at the four corners of the cross-section. They are held in place by the roof carlines, side posts and floor, to form a structure which has a high bending and impact strength. These longitudinal members are connected at the end of each car

Fig. 15. — The « Comet », New York, New Haven and Hartford Railroad.

by bulkheads, ridigly cross-braced, which transmit the stresses to the articulated couplings. The outside paneling is so fastened to the body framing that both can develop a high percentage of the strength of the unit. This arrangement provides a body which has a bending and impact strength well in excess of what is considered safe practice.

The tubular construction employed in the « Comet » places most of the material in the outer shell, and since by locating the strength members at the greatest possible distance from the center of gravity of the cross-section the maximum moment of inertia is obtained, the deflection in the fully loaded cars is less than one-sixteenth of an inch. The torsional rigidity is so high that the car can be supported on one side and at one end with only one-sixteenth of an inch torsional deflection on the opposite side.

With weight reduction and safety paramount factors in the design of the « Comet », aluminium was selected as the main structural material. In its strong alloys, it has approximately the same strength as structural steel, but weighs only one-third. This permitted the use of more rugged sections which, so far as the strength-weight ratio is concerned, could not be duplicated in the steels commonly used in car construction. In the case of the high-strength steels, the sections would have been one-third the cross-sectional dimensions for equal weight.

The resistance of aluminum to corrosion under the conditions encountered

on the sea coast lines of the New Haven, and the fact that the metal can be obtained in extruded as well as rolled shapes, may be considered as secondary factors which led to the adoption and use of aluminum in the construction of the « Comet ». The aluminum sections

Fig. 16. — The « Comet », New York, New Haven and Hartford Railroad.

are assembled by means of aluminum rivets driven cold. The rivet alloy was selected after a series of tests at the Goodyear-Zeppelin plant, in Akron, and combines ease of driving with excellent corrosion resistance. The shear value of the rivets and the bearing value of the metal in which they are driven make possible a highly efficient joint. The « Comet » is the first train which has been built with aluminum rivets throughout.

The four longitudinal tubular members are tied into heavy welded steel end-sills through the end bulkheads. The center vestibules are formed by two strong diagonally braced bulkheads. Diagonal members at the corners of the end bulkheads provide lateral rigidity and help to distribute the stresses due to shocks up into the whole circumference of the tubular car body. Since the shear is least at the center of the car, the shear deflection is reduced appreciably by placing the door at this point.

The underframe consists of two lower longitudinal tubular members connected with transverse floor beams, spaced 39″ on centers, and having a depth of 21″ at the center. These are braced by supplementary longitudinal members forming a series of rectangular compartments, in which various parts of the equipment are located and easily accessible through trap doors in the floors. The underside of the underframe consists of sheeting attached to the floor framing.

The car floor consists of Keystone flooring, with cork filler, and one-half inch sheet cork as insulation. Rubber is employed as the top flooring.

The roof structure is formed by connecting the two upper longitudinal tubular members with pressed sheet carlines. It is braced longitudinally by six intermediate purlines. The sheathing is formed from heavy gauge sheet. Because of its unusual thickness and the small size of the panels employed, the roof is extremely rigid and capable of carrying a heavy bending load without wrinkling.

The two end cars have the same type of construction as the center car, except for the extreme ends in which the power plants are located. In the engine room,

the underframe is composed of a welded steel bedplate, which rests on the longitudinal tubular members that have been reinforced in this area to take care of the greater weight. The bedplate is 20 feet long and 11 inches deep and serves as the lower half of the crankcase of the Diesel engine. It is formed by a top and bottom plate reinforced with longitudinal and transverse bulkheads which also provide a series of compartments for the storage of fuel, lubricating oil and water. All brackets required for the structural connections, the main bulkhead at the body bolster and the connection to the rounded front end of the car are welded to the bedplate. To facilitate the removal of the engine from the car, the section of the roof immediately above the bedplate is removable.

Each end of the train forward of the power plant involves a design which contributes to extreme rigidity. The two lower longitudinal tubular members are formed into an arch at the end of the car and riveted into a welded steel structure. The lower portion of this welded steel member forms the pilot, while the rear portion is connected to the floor structure and to a heavy shear plate. It also forms the pocket for the stationary draft gear and a removable coupler which is carried inside the train when it is running under its own power.

The front post, which is connected with the welded steel front member, is tied in with two arches composed of the upper and lower edges of the window-frame girders, and on the top flares out in the form of a « Y » into the two upper longitudinal tubular members which are arched to meet with it.

The entire framework is covered with thick plates, as is the bottom of the underframe. This results in a complete shell reinforced by the framework, window posts and bulkheads. The front ends are designed so that they may be removed at the front engine room bulkheads and replaced by new ones without reducing the strength at the points of connection, thus minimizing the period the train is out of service for repair.

Rubber has been very extensively used on this train, for example : rubber spring cushions, rubber side bearing springs, weather stripping, engine mountings, and flooring.

This is the first train of this type to be built in the United States and its testing and operation will be watched with keen interest.

The « Flying Yankee ».

The « Flying Yankee » was built to replace steam equipment on a 730-mile per day run between Boston, Massachu-

Fig. 17. — The « Flying Yankee », Boston and Maine, and Maine Central Railroads.

setts, and Bangor, Maine, running over the lines of the *Boston and Maine* and *Maine Central Railroads.*

This is also a 3-car articulated lightweight streamlined train.

The first of the three units in the train contains the power plant, a small baggage compartment which includes the oil-fired heating boiler, a buffet and seating space for 28 passengers. The second unit is divided by a partition near the center, the forward compartment seating 24 passengers and the rear one 36. The trailing section includes toilet facilities, a forward passenger

Fig. 18. — Front view of the « Flying Yankee ».

compartment, seating 32 and a lounge with chairs for 20.

Swing-type double doors are located near the center of each car. These have step wells which are closed by traps so that the streamlining of the cars is continuous when the traps are closed.

A feature of the car construction is the space under the floor, which includes piping, conduit, air conditioning equipment and other auxiliary apparatus. The space is closed with light hatch covers.

The car-body structure (1). — To a very large extent the entire body structure of the train from floor to roof performs load-carrying functions. The Budd form of truss construction, which employs built-up sections of thin-gage stainless steel, is used. The truss members are generally of box sections formed of deep flanged channels and cover plates joined by the Shotweld system. The 18-8 steel of which these sections are formed has a minimum tensile strength of 150 000 lb. per sq. inch and an elastic limit of 120 000 lb. per sq. inch, with satisfactory ductility.

All welding in the structure of the Flying Yankee was done by the Shotweld process, developed and patented by the Edward G. Budd Manufacturing Company. This effects a specific regulation of the pressure, the electric current value and the duration of its flow, thus maintaining unimpaired the strength and the corrosion-resisting properties of the material. The welds will withstand torsion up to 90°. They develop a shearing strength of 75 000 lb. per sq. inch.

The floor forms a stiff horizontal girder through which end loads are distributed to the side girders. Its structure is made up of a corrugated sheet of stainless steel, the bottoms of the rectangular corrugations of which are welded to a flat sheet and both in turn welded to the longitudinal stringers, of which there are ten across the car. These, in turn,

(1) This paragraph is reproduced from *The Railway Age,* as well as figures 18 to 28 incl.

Fig. 19. — The « Flying Yankee ». — Observation lounge.

are secured to transverse supports built into the car frame.

In addition to the compressive strength of the floor which, by itself, is sufficient to satisfy R.M.S. requirements for buffing conditions, there is included a center sill design according to R.M.S. specifications for a 50 % heavier train. In the baggage compartment the floor is designed for a loading of 600 lb. per lineal foot.

The roof is designed to assume the entire compression load. It is built up of longitudinal corrugated sheets welded to roof carlines and is locally reinforced at points of maximum stress. The enclosure below the floor is not a primary part of the load-carrying structure, except at the baggage doorway where it is reinforced to serve much the same purpose as the roof. Longitudinal trusses which extend from end to end of each underbody between the sides and center sills serve to add torsional stiffness to the entire structure and are reinforced at the step wells. Between them is a clear space, closed with light hatch covers, in which all piping, tanks, etc., are disposed.

The engine bed, fabricated by Lukenweld, Inc., is a rigid arc-welded structure of steel plate, annealed after completion of the welding. It forms a combination bumper, engine bed and bolster. The material is Lukens Steel Company Cromansil, with a tensile strength of 90 000 lb. and an elastic limit of 70 000 lb., possessing a high resistance to fatigue and shock. It is built into the lower chord member of the side trusses and forms the foundation for the nose structure of the car. All vertical end

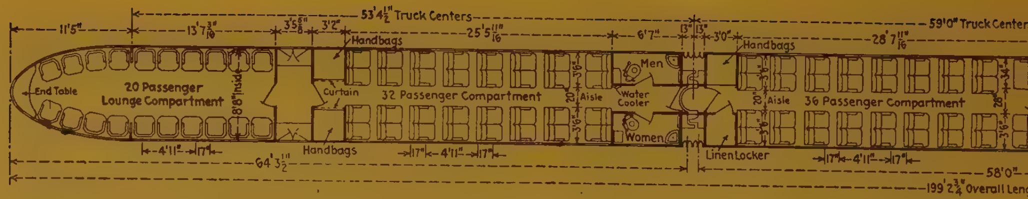


Fig. 20. — Floor pla

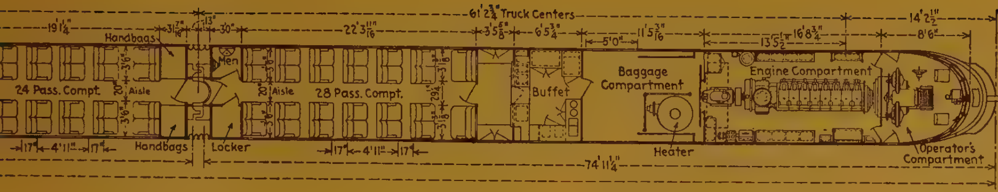
members are framed into pockets in its top member. In order to reduce the local deflections at the bolster beam of the rear truck and near the articulation castings it was necessary to limit the stresses to a rather low figure. Similarly fabricated members are built into the car structure at these points. Near the articulation castings these members are combined center sills and needle beams which bring the entire side-truss structure into play to resist the bending set

Fig. 21. — The « Flying Yankee ». — Welded Cromansil bolster and rear center member.

up in the center sills and floor structure by the eccentric center-plate loading of the articulation casting.

The nose construction consists of a deep, stiff diagonal member in the vertical center plane of the car which is reinforced with a stiff horizontal arch at the belt rail and with a diaphragm which forms the bottom of the engine-cooling air-intake chamber above the cab windows. This diaphragm consists primarily of two horizontal beams sloping back from the central collision post diagonally to the upper side structure rail. A tie bar across the car resists the spreading action resulting from a blow on this collision beam. These horizontal beams also serve as the top support for the intermediate posts around this end, all of which are reinforced for maximum collision protection.

The articulation castings are tied into the bodies by riveting to the end posts and frame and also to the Cromansil reinforcements at the end of the center sills. No rivets other than those connecting the end-sill castings, engine beds, needle beams and the rear bolster beam to the side frame are used in the car structure. The transverse horizontal arms of the castings extend out only far enough to carry the side bearings, and the load is carried to the side frames through the end truss structure. Through the stiff end structure the reaction from the weight on the truck center is carried to the main side frames. The bending moment due to the eccentric loading at the articulation center pins



Flying Yankee ».

is distributed to the center sill and the deep vertical end posts of 1/8-inch stainless steel.

The deadlight panels are finished with smooth surfaces. These laminated panels, some of which are of unusual length, are flexibly attached at the belt and upper moldings, sealed with plastic calking material and secured by means of bolts. They are stainless steel outside, copper inside with a wood lamination between.

The space below the floor level is enclosed with light corrugated sheathing similar to the roofing, with light hatch sections under the center. This sheathing is insulated with 1/2-inch hair felt stitched between two layers of 80-lb. waterproof Craft paper, the outer side of which is cemented to the sheathing, an arrangement which prevents resonance.

The side walls and roofs of the cars are insulated throughout with a 2-inch Dry-Zero blanket. This material is very light in weight and combines very low conductivity with added sound-deadening qualities.

In the coach compartments the side walls and headlining are finished with Masonite panels. The headlining in the lounge compartment is of molded Agasote. The walls of the baggage compartments are of corrugated galvanized sheets. The floors are laid with 5/16-inch cork tile, cemented to the corrugated steel flooring. In the baggage compartment two layers of heavy roofing paper are applied between the 7/8-inch tongue-and-groove maple and the corrugated steel flooring.

Swing type, double doors serve the passenger compartments at the step wells, which are closed by trap doors. The bottom step folds up when the trap is closed and, with the doors, forms an unbroken surface with the adjoining outside sheathing. The side doors in the baggage compartment are of the sliding type, guided in top and bottom tracks to move the door outward into a flush position when closed.

Vestibule passages between the car bodies are enclosed by elastic diaphragms bolted to the ends of the cars. The foot plate is formed by a semi-circular plate, its straight edge secured to

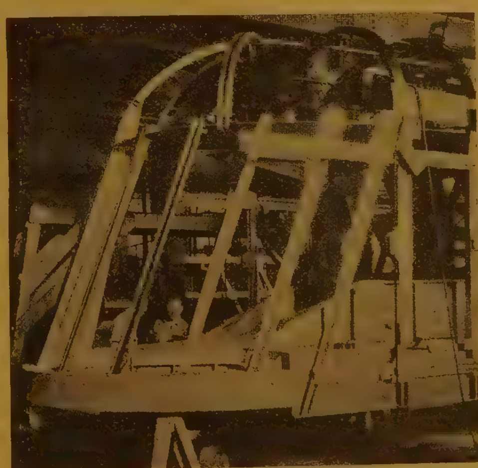


Fig. 22. — The « Flying Yankee ». — Front end of the train under construction.

the end of one car and the circular edge enclosed in a horizontal recess in the end of the opposite car within which it is free to slide when the cars pass over curved track. To provide continuity of the outer surfaces accordeon type diaphragms are attached between the ends of adjoining cars.

All side windows are flush with the outside surface of the train. With the exception of the doors and the curved sash in the lounge compartment, they are glazed with double hermetically sealed units, as furnished by the Pittsburgh Plate Glass Company, and are made up of two pieces of 1/4-inch special Duplate shatterproof glass having 1/4-inch dry air space between. In order to overcome the severe weathering a special plastic sheeting is used, which is highly resistant to the ultra-violet sun rays. The glass is developed to almost entirely filter these rays. These two pieces of glass are framed with a stainless-steel band to protect the edges. The special features of these hermetically sealed units is that condensation and frost will not form in the air space between the two pieces of glass. Special attention has been given to the re-glazing of the window sash, it being so designed that all this work can be done from the outside of the car.

Diesel-electric power plant. — Power originates in a Winton 600-H.P., high-compression two-cycle 8 in. by 10 in. eight-in-line diesel engine, weighing about 22 lb. per H.P. The main generator with differential exciter, auxiliary generator, pneumatic control and traction motors were built by the General Electric Company.

Fig. 23. — The 600-H.P. Winton two-cycle diesel engine of the « Flying Yankee ».

The main generator is a single-bearing differentially controlled machine placed forward of the engine and directly connected through a flexible steel-disc coupling. The direct-connected exciter is used for generator excitation purposes, to give inherently the generator characteristic which permits full engine utilization over a wide range of train speeds. A shaft extension is provided at the exci-

ter end of the main generator to drive, through V-belts, a 35-kw. auxiliary generator mounted above the main one. The opposite end of the auxiliary generator shaft is also extended for V-belt connections to the two radiator fans which draw air into the engine room.

The two series-wound traction motors are on the front truck of the leading car. They are mounted on the driving axles and have a double nose for spring support on the truck bolster. The gearing is single reduction with a 22-tooth pinion and a 61-tooth gear. The armatures have roller bearings. The motors are self-ventilated by multiple fans mounted at the pinion ends of the armatures. Ventilating air to the motors is taken from the engine room through ducts.

Motor control consists essentially of a master controller, electro-pneumatically operated motor contactors, and reverser, together with the necessary auxiliary magnetic contactors, switches, relays, etc. The control provides for operation from the front of the train only and for starting and stopping the engine, regulating headlights, cab lights, etc. As the train is started, the traction motors are progressively connected in series, parallel and parallel-shunted-field combinations.

Fig. 24. — The power truck of the « Flying Yankee ».

The 35-kw. 76-volt direct-current auxiliary generator supplies power to the air compressors, air-conditioning equipment, motor for train-heating boiler, battery charging, lights, contrôl, buffet ustensils, etc., at a constant voltage regardless of load, over a range of engine speed from idling to full speed.

A battery is used for starting the engine, through the main generator, as well as for supplying power to the auxiliary circuits. The storage battery is an Exide 32-cell 64-volt battery, rated at 450 amp.-hours at the 10-hour discharge rate. It is arranged in tiers along the walls of the engine compartment. Adequate ventilation is assured by the rapid circulation of cooling air through the engine room.

Lighting and interior decoration. — The four forward passenger compartments are lighted by indirect light. The lamps are concealed within longitudinal coves below the ceiling along each side of the car. The coves toward the sides of the car are open and the light, reflected from the curved inner surfaces of each cove and against the curve of the ceiling of the side of the car, is diffused in a wide angle which reaches completely across the car at the reading plane. The illumination on each side of the car is thus received from the lights in both conduits. The exterior of the conduit is

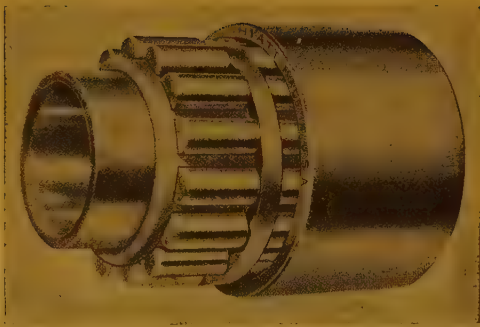


Fig. 25. — The Hyatt roller bearing applied on the truck journals of the « Flying Yankee ».

Fig. 26. — Installation of Houdaille shock absorbers on one of the trailing trucks of the « Flying Yankee ».

blended into the surface of the ceiling by smooth flowing curves.

Twenty-five-watt lamps are used in each conduit, spaced 14 and 15 inches apart. The interior of the ducts is painted white and a lighting intensity of 8 foot-candles at the reading plane is claimed. All of the lamps used are 32-volt lamps, except those in the headlight and backup lights. The lamps in the troughs are wired two in series, alternate lamps being so connected.

The lounge is lighted directly through diffusing glass which covers the underside of long ducts placed along the walls just above the windows. The light is supplied by 25-watt lamps in double Arrow, Hart & Hageman sockets, wired in series to provide for the 32-volt lamps.

The front headlight is a 14-inch 250-watt 64-volt Golden Glow unit, made by the Electric Service Supplies Company. The backup light is a 9-inch 40-watt unit made by the same manufacturer. The marker and classification lights are Pyle-National airplane wing lights, in housings made by the Budd Company. These lights are all built into the body of the train. Electric Service Supplies Company dome lights are used in the vestibules, and safety deep bowl units are used in the buffet and baggage section. The total lighting load is 100 amperes at 64 volts.

The ceilings of the cars are finished in ivory. The side walls, including the deadlights up to the tops of the windows and the ends of the compartments to the ceilings, are a deep shade of blue-green. The mohair upholstering is a taupe shade and window drapes are lemon-gold, striped with brown. The window shades have a neutral pattern on the inside which harmonizes with the color scheme of the interior. The outside facing has an aluminum finish which matches the stainless-steel exterior.

Buffet employs electric heat. — The buffet is equipped to supply grill service, to serve ice cream and both hot and cold drinks. It occupies a compartment 6 ft. 6 in. long across the center of the first car, and includes refrigerator space, two electric grills, an urn for hot water, a coffee percolator, storage for dishes, cupboards for storage of foods, ustensils, etc. Service will be provided at seats in the passenger compartments. The heating units in the two grills are rated at 1 320 watts and those in the percolator and water heater are

each 1 100 watts. They may be supplied either from the generator or lighting train lines by plugging into the receptacles on the back wall of the buffet. An exhaust fan located in the ceiling, driven by a 0.7-amp, motor, keeps the air in the buffet clean.

Air-conditioning. — Year-round air conditioning is furnished. The major units used consist of two motor-driven refrigerating units located in the second and third cars, respectively, and an oil-fired heating boiler in the baggage compartment of the first car. Steam from the boiler is piped through the train, and the passenger compartment in the first car is cooled by an evaporator which receives compressed Freon from the second car refrigerating unit. Flexible connections are provided in the Freon line between cars.

The heating equipment and air-conditioning control were furnished by the Vapor Car Heating Company. The oil-fired Peter Smith boiler has an evaporative capacity of 500 lb. per hour at a pressure of 85 lb. The operation of the boiler is entirely automatic once it has been started.

The boiler is fitted with a water-level control, a low-water control and a burner-load control. The water-level and low-water controls are of the electrode type. Current at 110 volts, furnished by a small motor-generator set, passes from the electrodes to the grounded metal container through the water. If the water drops below the end of the longest electrode, the failure of the current acts to close the oil-supply valve and stop the burner motor. A variation of the water between the ends of the intermediate and short electrodes serves to cut the feed pump in or out.

For light loads, a pressure switch operates automaticaly to reduce the flow of oil to the burner and the speed of the burner motor, thus maintaining a flame which is little more than a pilot light until such time as the reduction in pres-

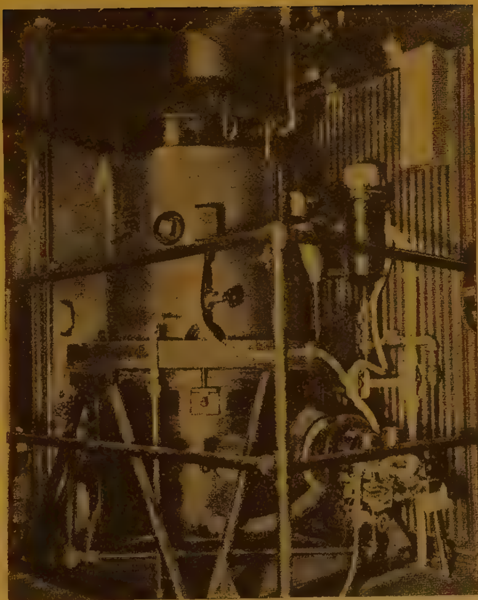


Fig. 27. — The heating plant of the « Flying Yankee ».

sure restôres combustion to the full-load amount. The burner motor which supplies forced draft for combustion is driven by a General Electric motor, rated 5.8 amperes at 73 volts. Heating is supplied to the passenger compartments from fin-tube coils in the evaporator units of the air-conditioning system, the fresh and recirculating air passing through the units to the compartments. Steam is also supplied to a copper fin-pipe near the floor on each side of the compartment. The admission of steam to both radiators is controlled by a separate Vapor regulator and a magnet valve, the latter being actuated by a thermostat.

The two compressors and condensor units are housed beneath the floor of the second and third cars, while the evaporators having distributing fans are built into the roof above the vestibules. Fresh air is taken in through the doors into the vestibules, and is then passed through filters where it is mixed with re-circu-

lated air in the proportion of about 1 to 5.

Two combination cooling and heating coils are located in the evaporator, and between them are two double blowers driven by 1/4-H.P. motors which project the conditioned air through centrally located grills into opposite passenger compartments. The air is returned through grills at either side of the partitions in the roof. Washable filter pads are also used in the return grills. The capacity of each refrigerator system is 5 1/2 tons. Separate 1/4-H.P. motors are used to force cooling air through the condensors.

The heat reflecting properties of the bright stainless-steel car exterior will reflect much heat from the car. All of the windows and side walls and roofs of the cars are insulated throughout with a 2-inch Dry Zero blanket.

Fig. 28. — The « Flying Yankee ». — Piping, wiring, tanks and air-conditioning compressors are accessible through hatches in the underbody.

Wiring. — Two two-wire train lines are run through the length of the train under the floors of the cars. These consist of two 350 000 cm. and two 2/0 Okonite stranded cables. Where these are run in conduit, one 350 000 cm. and one 2/0 wire are carried in 2-inch conduit.

The larger train line is connected directly across the auxiliary generator terminals, the voltage on this line being controlled within narrow limits, at approximately 73 volts, by the generator-voltage regulator. The battery is floated across this line, and to it are also connected all motors and normally the heating units in the buffet.

Voltage on the 2/0 train line is controlled by Safety carbon-pile regulators which serve to connect it to the larger train line. The voltage on the 2/0 line is maintained at 64 volts. It supplies the lights, annunciators and other auxiliary apparatus.

A large junction box is placed under the floor near each end of the car. These boxes are connected by a rectangular metal wiring duct built into the car. From the junction boxes to the connection boards at the ends of the cars, the two train lines and 16 control wires are carried in two 2-inch and one 1 1/2-inch thin-walled steel conduits, respectively. Between the junction boxes, these wires are run in the rectangular duct. Branch circuits are run from the junction boxes in thin-walled conduit. Malleable-iron Appleton Unilets are used with the thin-walled conduit. Insulated wire for branch circuits was supplied by National Electric Products Company.

Plug and socket connectors are not used between cars. Train line and control wire circuits are terminated at each end of a car on stud panels. Jumpers between cars are connected permanently to the studs on these panels.

All lights inside the car and also all auxiliary apparatus are controlled through General Electric load centers. Only one provision is made for receiving power from an outside source. This consists of a Pyle-National receptacle located in the side of the first car near the forward end. It will receive direct current power at about 80 volts.

* * *

Underframe and body.

In part « A » of this report *(Bulletin of the Railway Congress*, January 1935, p. 711) was included a tabulation, « Rails cars put in service between the years 1923 and 1932 » (United States, Canada, Mexico); the lengths of the various compartments were not included, as it was felt that such information belonged to part « B » or second section, and they are therefore listed hereafter (table III). (See pp. 696 to 704).

The majority of roads reporting advise that only all-metal cars are given consideration. Most of them recommend bodies being so designed as to jointly with the frame form a strength member, as regards resistance to all shocks and stresses to which they are or may be subjected, including those occasioned by wreck or collision and the strains set up when wreckers are used to pick up the wreck.

The head end of a motor car or articulated motor train is given extra reinforcement or collision protection, as a rule, in both underframe and body, to a less degree at the rear and at the ends of the intermediate sections.

These new types of equipment have not as yet been long enough in service to determine future standards of construction, but all indications point to the body combining all members into one integral stress and shock resisting unit.

The question of the articulated train versus the train made up of motive power units and individual self supporting trailing cars is not one that can be arbitrarily answered. Only by experience, and that experience on a broad scale, will we be able to determine the answer.

Materials used for and methods of erection of rail motor cars.

The lines reporting indicate that we have not yet gone far enough in the use of new metals, and the various possible methods that may be followed in their fabrication, to tabulate replies advantageously.

The use of aluminum and stainless steels under various trade names for building light-weight cars is not a simple matter. The determination of material forms best suited for the detail job in hand, rolled sections — pressings — castings, the best and most economic method of fastening together is, when all the design factors are considered, most difficult.

In the United States, to date the use of aluminum and that of stainless steel for light-weight passenger cars have been about evenly divided with other steels.

The efficient use of rivets and the welding of light or thin steel sections does not seem to have been perfected, and the riveting of aluminum has presented some economic difficulties.

In choosing the metal to be used in constructing a modern, light-weight train, all of the factors and characteristics must be taken into consideration, as well as the cost per pound.

For example :

Type of steel.	Yield point, pounds.	Ultimate strength, pounds.
Ordinary steel . . .	30 000	45 000
Corten steel . . .	55 000	70 000
Cold rolled stainless steel	120 000	150 000

TABLE III.

RAILROAD.	Length of engine compartment.	Length of baggage compartment.	Length of mail compartment.	Length of passenger compartment.
Atchison, Topeka & Santa Fe	combined	16′ 3″	...	33′ 11″
	13′ 2″	11′ 2″	...	46′ 8″
	13′ 2″	11′ 2″	...	41′ 9″
	15′ 9″	...	15′ 1″	35′ 7″
	15′ 9″	...	15′ 1″	35′ 7″
	15′ 9″	35′ 3″	...	25′
	15′ 9″	20′ 1″	15′ 1″	25′
	15′ 9″	20′ 1″	15′ 1″	25′
	15′ 9″	...	15′ 1″	35′ 7″
	15′ 9″	35′ 3″	...	25′
	15′ 9″	18′ 5″	15′ 1″	26′ 5″
	15′ 9″	43′ 4″	15′ 1″	...
	15′ 9″	48′ 3″	15′ 1″	...
	15′ 9″	48′ 3″	15′ 1″	...
	30′ 6″	58′ 6 3/8″	...	...
Baltimore & Ohio	combined	11′ 8″	...	15′ 4″
	combined	16′ 3″	...	27′ 3″
	6′ 10 1/4″	25′	...	18′ 6″
	13′	...	...	42′ 0 1/2″
	13′	...	...	42′ 0 1/2″
	13′ 5 1/2″	...	...	42′ 0 1/2″
	13′ 5 1/2″	...	...	42′ 0 1/2″
	13′ 5 1/2″	...	...	39′ 10″
	11′ 5 1/8″	17′ 5 7/8″	15′ 1″	11′ 3 1/2″
	16′ 5″	17′ 0 3/4″	...	35′ 6″
Boston & Maine	...	16′ 5″	...	20′ 9″
	...	24′	...	25′ 11″
	...	15′ 8″	...	17′ 11″
	7′ 9″	16′ 6″	...	26′ 2″
	...	31′ 9″	...	18′ 4″
	11′ 11″	16′ 2″	...	28′ 7″
	11′ 11″	16′ 2″	...	28′ 7″
	11′ 7″	...	...	54′ 6″
	9′ 6″	16′	...	28′ 11″
	9′ 6″	12′	...	44′ 11″
Burlington-Rock Island	15′ 9 5/8″	43′ 3 1/8″	15′ 1 1/8″	...
Canadian National	...	23′	...	23′ 4″
	...	11′ 6″	...	22′ 10″
	...	...	...	43′
	...	13′ 8″	...	34′ 2″
	...	11′ 3″	...	25′ 10″
	8′ 3″	16′	15′ 2″	11′ 8″
	13′	19′ 2″	...	20′ 6″
	17′ 6″	16′ 6″	...	55′ 9″
	13′ 8 1/8″	...	...	34′ 2 3/8″
	16′ 10″	27′ 3″	...	22′ 8″
	13′ 8″	...	...	34′ 2″
	4′ 6″	11′ 3″	...	25′ 10″
	14′ 1″	24′ 5 1/2″	...	15′ 5 5/8″
	16′ 10″	27′ 3″	...	22′ 8″
	16′ 10″	27′ 3″	...	22′ 8″
	16′ 10″	27′ 3″	...	22′ 8″
	16′ 10″	56′ 11″	...	...

RAILROAD.	Length of engine compartment.	Length of baggage compartment.	Length of mail compartment.	Length of passenger compartment.
Canadian Pacific	12′ 2 1/2″	...	...	25′ 9 1/2″
	15′ 10″	20′ 2 1/2″	...	32′ 1″
	15′ 10″	20′ 2 1/2″	8′ 9″	23′ 4″
	15′ 10″	34′ 6 1/2″	...	17′ 9″
Central of Georgia	combined	17′ 8″	...	15′ 9 13/16″
Central Vermont	11′ 6 5/8″	14′ 11″	...	28′ 8 1/2″
	11′ 6 5/8″	14′ 11″	...	28′ 8 1/2″
	10′ 6 1/2″	12′ 8″	7′ 10″	15′ 6″
	11′ 6 5/8″	30′ 5″	...	13′
Chesapeake & Ohio	combined	41′	...	...
	combined	13′ 10 3/32″	...	20′ 8″
	combined	13′ 10 3/32″	...	20′ 8″
	combined	13′ 10 3/32″	...	20′ 8″
	11′ 10 5/8″	19′ 10 1/8″	15′ 1″	25′
	11′ 10 5/8″	19′ 10 1/8″	15′ 1″	25′
	11′ 10 5/8″	19′ 10 1/8″	15′ 1″	25′
	11′ 10 5/8″	19′ 10 1/8″	15′ 1″	25′
	11′ 10 5/8″	19′ 10 1/8″	15′ 1″	25′
Chicago & Alton	8′ 3 1/4″	16′ 6 3/4″	...	26′ 3″
	8′ 3 1/4″	42′ 9 3/4″	...	...
	8′ 3 1/4″	31′ 1 3/4″	...	11′ 8″
	10′ 0 1/2″	31′ 3″	15′ 2″	11′ 8″
	10′ 0 1/2″	58′ 1″	...	...
	10′ 0 1/2″	22′ 6″	15′ 2″	20′ 5″
	10′ 0 1/2″	42′ 11″	15′ 2″	...
Chicago & Northwestern	8′ 3 1/4″	19′ 5 3/4″	...	23′ 4″
	8′ 6 1/2″	16′ 8″	15′	26′ 3″
	10′ 0 1/2″	16′ 8″	15′	26′ 3″
	10′ 0 1/2″	16′ 8″	15′	26′ 3″
	10′ 0 1/2″	16′ 8″	15′	26′ 3″
	10′ 0 1/2″	16′ 8″	15′	26′ 3″
	10′ 0 1/2″	16′ 8″	15′	26′ 3″
	10′ 0 1/2″	16′ 8″	15′	26′ 3″
	10′ 0 1/2″	16′ 8″	15′	26′ 3″
	10′ 0 1/2″	16′ 8″	15′	26′ 3″
	10′ 0 1/2″	16′ 8″	15′	26′ 3″
	15′ 5 1/2″	33′ 8 1/2″	15′	...
	10′ 0 1/2″	46′ 1 1/2″	15′	...
	10′ 0 1/2″	16′ 8″	15′	26′ 3″
	10′ 0 1/2″	34′ 9″	...	23′ 4″
	10′ 0 1/2″	...	15′	35′ 11″
	16′ 3 5/8″	...	...	44′ 4″
	16′ 3 5/8″	...	...	44′ 4″
	13′ 4″	16′ 4″	15′	26′ 3″
	18′	32′ 8 1/2″	...	20′ 5″
	13′ 4″	35′ 10″	15′	...
	18′	41′ 2″	15′	...
	18′	41′ 2″	15′	...
Chicago, Burlington & Quincy	...	17′ 2″	...	22′ 7″
	...	17′ 2″	...	22′ 7″
	...	19′ 7″	...	20′ 2″

RAILROAD.	Length of engine compartment.	Length of baggage compartment.	Length of mail compartment.	Length of passenger compartment.
Chicago, Burlington & Quincy (contd)	...	26′ 10″	...	12′ 11″
	11′ 11 3/4″	27′ 8″	...	21′ 11″
	11′ 10 5/8″	14′ 6″	...	29′ 1″
	10′ 0 1/2″	24′ 3″	15′	11′ 8″
	10′ 0 1/2″	27′ 2″	15′	8′ 9″
	10′ 0 1/2″	39′ 1″	15′	...
	10′ 0 1/2″	26′ 1″	...	35′
	10′ 0 1/2″	29′	...	32′ 1″
	10′ 0 1/2″	22′ 7″	15′	23′ 4″
	10′ 0 1/2″	25′ 6″	15′	20′ 5″
	10′ 0 1/2″	28′ 5″	15′	17′ 6″
	10′ 0 1/2″	26′ 1″	...	35′
	10′ 0 1/2″	...	...	51′ 1″
	10′ 0 1/2″	24′ 10″	...	26′ 3″
	10′ 0 1/2″	30′ 8″	...	20′ 5″
	10′ 0 1/2″	30′ 8″	...	20′ 5″
	10′ 0 1/2″	36′ 6″	...	14′ 7″
	10′ 0 1/2″	...	15′	35′ 11″
	10′ 0 1/2″	21′ 4″	15′	14′ 7″
	10′ 0 1/2″	39′ 1″	15′	...
	10′ 4 1/2″	25′	...	35′
	15′ 9 5/8″	29′	...	26′ 3″
	10′ 0 1/2″	40′ 8″	...	20′ 5″
	15′ 9 5/8″	...	15′	40′ 2″
	10′ 0 1/2″	22′ 7″	15′	23′ 4″
	10′ 0 1/2″	25′ 6″	15′	20′ 5″
	10′ 0 1/2″	28′ 5″	15′	17′ 6″
	10′ 0 1/2″	28′ 5″	15′	17′ 6″
	15′ 9 5/8″	33′ 3″	15′	...
	15′ 9 5/8″	33′ 3″	15′	...
	15′ 9 5/8″	43′ 3″	15′	...
	15′ 9 5/8″	43′ 3″	15′	...
Chicago Great Western	3′ 6″	16′	...	21′
	8′ 2″	16′ 8″	...	26′ 3″
	4′ 4″	19′ 11″	...	16′ 1 1/2″
	4′ 4″	35′ 11 1/2″	...	16′ 1 1/2″
	14′ 5 3/4″	8′ 6″	...	44′ 5″
	17′ 11 1/2″	45′ 8″	...	...
Chicago, Milwaukee, St Paul & Pacific	12′ 11″	40′ 9″	17′ 2″	...
	10′	43′ 8″	17′ 1″	...
	10′	23′ 3″	...	35′
	12′ 11″	20′ 4″	...	35′
	12′	31′ 7″	17′ 1″	...
	12′	31′ 7 1/8″	17′ 0 7/8″	...
Chicago, Rock Island & Pacific	8′ 9″	8′ 9″	...	21′
	9′ 5 1/2″	16′ 9″	...	38′ 9″
	9′ 4 1/2″	7′ 4 1/2″	...	30′ 10″
	10′ 0 1/2″	11′ 5″	...	46′ 6″
	16′ 8″	18′ 10″	...	...
	10′ 0 1/2″	16′ 8″	15′	21′ 3″
	10′ 0 1/2″	16′ 8″	15′	26′ 3″
	34′ 2″	7′ 6 3/4″	...	...
	36′	7′	...	...
	16′ 6″	24′ 4 1/4″	...	27′ 3 1/4″
	16′ 6″	33′ 1 1/2″	15′ 2″	...
	14′ 9″	34′ 9 1/4″	15′ 2″	...
	10′ 0 1/2″	16′ 8″	15′	26′ 3″

RAILROAD.	Length of engine compartment.	Length of baggage compartment.	Length of mail compartment.	Length of passenger compartment.
Chicago, St. Paul Minn, & Omaha	10′ 0 1/2″	16′ 1″	...	35′
	10′ 0 1/2″	8′ 6″	...	49′ 7″
	18′	25′ 7 1/2″	...	17′ 6″
	18′	20′ 4 1/2″	15′ 2″	14′ 7″
	18′	38′ 2″	15′ 2″	...
	18′	22′ 8 1/2″	...	20′ 5″
Cleveland, Cincinnati Chicago & St. Louis	3′ 6″ (3)	23′	17′ 3″	...
	8′ 3 1/4″	33′ 10 3/4″	15′ 2″	...
	10′ 5″	30′ 1″	15′	...
	15′ 4″	44′ 6″	15′ 1″	...
Colorado & Southern	15′ 10″	22′ 7 1/2″	15′ 2″	17′ 6″
	15′ 9 5/8″	59′ 2 3/8″	...	...
Columbus & Greenville	combined	16′ 3″	...	33′ 10″
	11′ 10 5/8″	30′ 5 7/8″	15′ 1″	11′ 3 1/2″
Detroit & Mackinac	11′ 9″	15′ 1″	15′ 1″	26′ 3″
	11′ 9″	15′ 1″	15′ 1″	26′ 3″
Detroit, Toledo & Ironton	...	13′ 10 3/16″	15′ 1 1/8″	34′ 11 1/4″
Duluth, Missabe & Northern	...	...	...	51′ 6″
	...	28′ 7″	...	23′ 6″
	...	27′ 3 1/2″	...	27′ 11 1/2″
Erie	...	11′ 6″	...	26′
	...	11′ 6″	...	26′
	...	11′ 6″	...	26′
	...	11′ 6″	...	26′
	...	14′ 3″	...	23′ 3″
	...	14′ 3″	...	23′ 3″
	...	26′ 6″	...	23′ 4 3/4″
	...	26′ 6″	12′ 5″	23′ 4 3/4″
	...	26′ 6″	...	23′ 4 3/4″
	11′ 8″	12′ 4″	...	31′ 2 1/4″
	11′ 8″	25′ 3″	...	18′ 3 3/4″
	11′ 8″	...	...	37′ 5 1/4″
	18′	23′ 1 1/2″	30′ 1″	...
	18′	23′ 2 3/4″	30′ 1″	...
	18′	...	15′ 2″	32′ 1 1/2″
	18′	53′ 4 3/4″	...	...
	18′	13′ 0 11/16″	...	33′
Great Northern	8′ 3 1/4″	13′ 6″	...	26′ 3″
	8′ 3 1/4″	16′ 6″	...	26′ 3″
	8′ 3 1/4″	13′ 6″	...	20′ 5″
	12′	9′ 6″	...	34′ 2″
	8′ 3 1/4″	49′	...	...
	8′ 3 1/4″	49′	...	...
	8′ 3 1/4″	34′	15′	...
	10′ 0 1/2″	46′ 6″	15′	...
	8′ 3 1/4″	16′ 6″	...	26′ 3″
	13′ 2″	31′ 6″	15′	...
	10′ 0 1/2″	40′ 6″	...	21′ 4 1/2″
	10′ 0 1/2″	40′ 7″	...	17′ 6″

RAILROAD.	Length of engine compartment.	Length of baggage compartment.	Length of mail compartment.	Length of passenger compartment.
Great Northern (contd)	11′ 10 5/8″	17′ 6″	15′	21′ 3″
	12′ 1 1/2″	45′ 9 1/2″	15′	...
	11′ 11 5/8″	45′ 9 1/2″	15′	...
	15′ 10″	41′	15′	...
	15′ 10″	26′ 2″	30′	...
	15′ 10″	41′	15′	...
	15′ 10″	26′ 2″	30′	...
	13′	31′ 6″	30′	...
	15′ 10″	41′	15′	...
Gulf, Mobile & Northern, New Orleans Great Northern	15′ 4″	19′ 5″	...	35′ 11 1/2″
Huntingdon & Broad Top Mountain R. R. & Coal Co.	15′ 10″	13′ 11 1/2″	...	36′ 8 1/2″
Illinois Central	7′ 6″	...	...	40′ 6″
	7′ 6″	20′	...	32′ 2″
Lehigh & Hudson River	15′ 10″	16′ 6 1/2″	...	36′ 8 1/2″
Lehigh & New England	10′ 6″	...	...	41′ 8 1/4″
	12′ 10 1/2″	...	...	40′ 11 3/8″
Lehigh Valley	combined	11′ 10″	...	25′ 10″
	8′ 3 1/4″	33′ 10 3/4″	15′ 2″	...
	8′ 3 1/4″	13′ 1 1/4″	...	32′ 1″
	8′ 3 1/4″	14′ 6″	15′ 4″	15′ 4 1/2″
	8′ 3 1/4″	18′ 11 1/4″	...	26′ 3″
	13′ 10″	41′ 6″	15′ 1″	...
	13′ 10″	40′ 11″	15′ 8″	...
	13′ 10″	40′ 9 1/2″	...	11′ 6″
	13′ 10″	25′ 8 1/2″	15′ 1″	11′ 6″
	14′ 1 1/2″	28′ 11″	...	23′ 4 1/2″
	14′ 1 1/2″	25′ 4″	15′ 3″	11′ 8 1/2″
	14′ 1 1/2″	14′ 4″	...	37′ 11 1/2″
	14′ 1 1/2″	20′ 2″	...	32′ 1 1/2″
	11′ 10 5/8″	9′ 5 3/8″	...	34′ 6″
	13′ 10″	25′ 8 1/2″	15′ 1″	11′ 6″
	8′ 3 1/4″	10′ 8 3/4″	...	32′ 1″
	13′ 10″	37′ 10 1/2″	...	14′ 5″
	15′	37′ 7 1/8″	...	14′ 9 1/16″
	15′	22′ 4 1/4″	15′ 3″	14′ 8 1/2″
	15′	34′ 9″	...	17′ 6 1/2″
	8′ 3/4″	13′ 7 3/4″	...	29′ 2″
	8′ 3/4″	...	...	42′ 9 3/4″
	18′	17′ 1″	...	32′ 2 1/2″
	18′	34′ 7″	...	14′ 8 1/2″
	18′	17′ 1″	...	32′ 2 1/2″
	18′	34′ 7″	...	14′ 8 1/2″
Long Island	combined	11′ 3″	...	25′ 10″
Louisiana & Arkansas	...	11′ 3″	...	25′ 6″
	...	16′ 3″	...	33′ 6″
Louisiana & Northwest	...	23′ 4″	...	26′ 6″

RAILROAD.	Length of engine compartment.	Length of baggage compartment.	Length of mail compartment.	Length of passenger compartment.
Louisville & Nashville	11′ 10 5/8″	9′ 4 7/8″	...	34′ 6 1/2″
Maryland & Pennsylvania	10′ 0 1/2″	...	...	40′ 10″
	15′ 10″	...	...	35′
Midland Valley	12′ 3″	20′	16′ 4″	17′ 4″
	12′ 3″	20′	16′ 4″	17′ 4″
Minneapolis & St. Louis	13′ 4 1/2″	22′ 2″	15′ 2″	20′ 5″
	15′ 10″	29′ 1″	30′ 1″	...
	13′ 4 1/2″	22′ 2″	15′ 2″	20′ 5″
	15′ 10″	29′ 1″	30′ 1″	...
	15′ 10″	44′	15′ 2″	...
Minneapolis, St. Paul & Sault Ste Marie	8′ 2″	10′ 8″	...	31′ 9 1/2″
Missouri-Kansas-Texas	...	26′ 6 1/2″	...	23′ 5 1/2″
	7′ 10″	19′	...	22′ 6″
	15′ 10″	44′	15′ 2″	...
	15′ 10″	44′	15′ 2″	...
Missouri Pacific	4′ 2″	12′ 4 1/2″	...	20′ 7″
	4′ 2″	15′ 1″	...	17′ 10 1/2″
	4′ 2″	7′ 3 1/2″	...	25′ 8″
	4′ 2″	15′ 1″	...	17′ 10 1/2″
	4′ 2″	12′ 4 1/2″	...	20′ 7″
	4′ 2″	12′ 4 1/2″	...	20′ 7″
	8′ 3 1/4″	9′ 9″	...	29′ 2 1/4″
	8′ 3 1/4″	10′ 2 1/4″	...	35′
	8′ 6 1/2″	26′	...	32′ 1″
	8′ 6 1/2″	26′	...	32′ 1″
	9′ 5 3/16″	12′ 6 13/16″	...	40′ 4″
	9′ 2″	...	...	36′ 1 3/4″
	9′ 2″	...	...	36′ 1 3/4″
	15′	29′ 1″	30′ 1″	...
Mobile & Ohio	8′ 6 1/2″	16′ 8″	15′ 2″	26′ 3″
	10′ 0 1/2″	16′ 8″	15′ 2″	26′ 3″
	14′ 10 1/2″	20′	15′ 2″	17′ 5″
	15′ 5 1/2″	41′ 4 1/2″	15′ 2″	...
National Railways of Mexico	8′ 2″	7′ 10″	...	37′ 4″
	5′	...	...	26′ 10″
	5′	...	...	26′ 10″
	5′	...	...	26′ 10″
	5′	...	...	10′ 3″
	7′	...	...	21′ 6″
New York Central	8′ 3″	30′	15′	...
	...	12′	...	34′
	...	16′	...	28′ 10″
	...	16′	...	28′ 10″
	...	16′	...	28′ 10″
	...	19′	...	25′ 10″
	...	19′	...	25′ 10″
	...	16′	...	28′ 10″

RAILROAD.	Length of engine compartment.	Length of baggage compartment.	Length of mail compartment.	Length of passenger compartment.
New York Central (contd)	19′ 5 7/8″	16′ 9″	...	31′ 5 5/8″
	13′ 3″	13′ 11 1/2″	...	39′ 3 1/8″
	13′ 3″	13′ 11 1/2″	...	39′ 3 1/8″
	11′ 6″	28′ 8 1/2″	...	25′ 10″
	11′ 6″	28′ 8 1/2″	...	25′ 10″
	10′ 4 1/2″	15′ 3″	...	42′ 8 3/8″
	13′ 3″	17′ 6″	17′ 1″	18′ 7 1/8″
	13′ 3″	17′ 6″	17′ 1″	18′ 7 1/8″
	13′ 3″	17′ 6″	17′ 1″	18′ 7 1/8″
	13′ 3″	17′ 6″	17′ 1″	18′ 7 1/8″
	13′ 3″	17′ 6″	17′ 1″	18′ 7 1/8″
	13′ 3″	17′ 6″	17′ 1″	18′ 7 1/8″
	16′	17′ 4″	17′	18′ 8 3/16″
	16′	17′ 4″	17′	18′ 8 3/16″
	16′	17′ 4″	17′	18′ 8 3/16″
	15′ 10″	13′ 11 1/2″	...	36′ 8 1/8″
	15′ 10″	22′ 4″	17′ 1″	13′ 5 1/8″
	11′ 6″	28′ 8 1/2″	...	25′ 10″
New York, New Haven & Hartford	8′ 2″	13′ 7″	...	29′ 9″
	...	11′ 10 1/2″	...	21′ 8″
	...	14′ 1 1/2″	...	20′ 5″
	...	7′ 1 1/2″	...	26′ 4 1/2″
	...	16′ 6″	...	23′ 2 5/16″
	...	9′ 3″	...	30′ 5 5/16″
	...	9′ 3″	...	30′ 5 5/16″
	10′	11′ 3″	...	32′ 3 1/2″
	11′ 2 1/8″	11′ 3″	...	44′ 1 1/8″
	11′ 2 1/8″	11′ 3″	...	44′ 1 1/8″
	11′ 2 1/8″	11′ 3″	...	44′ 1 1/8″
	11′ 6″	9′ 2 1/2″	...	32′ 3 1/2″
New York, Ontario & Western.	...	9′ 4″	...	24′ 6″
	11′ 2″	10′ 8 1/2″	10′ 0 1/2″	34′ 7″
Northern Pacific	8′ 2″	7′ 10″	...	35′ 1″
	8′ 3 1/4″	19′ 5 3/4″	...	23′ 4″
	8′ 3 1/4″	16′ 6 3/4″	...	26′ 3″
	8′ 3 1/4″	10′ 8 3/4″	...	32′ 1″
	8′ 6 1/2″	26′	...	32′ 1″
	8′ 6 1/2″	28′ 4″	15′ 2″	14′ 7″
	8′ 6 1/2″	22′ 6″	15′ 2″	20′ 5″
	10′ 0 1/2″	22′ 6″	15′ 2″	20′ 5″
	10′ 0 1/2″	46′ 9 1/2″	15′ 2″	...
	11′ 11 1/8″	26′ 2 3/8″	...	32′ 4″
	13′ 4 7/16″	22′ 2 1/16″	15′ 2″	20′ 5″
	13′ 4 1/2″	19′ 3″	15′ 2″	23′ 4″
	13′ 4 1/2″	28′	15′ 2″	14′ 7″
	13′ 4 1/2″	28′ 7″	...	29′ 2″
	18′	41′ 10″	15′ 2″	...
Oklahoma City-Ada-Atoka	10′ 8″	15′	...	22′
	8′	40′	...	...

RAILROAD.	Length of engine compartment.	Length of baggage compartment.	Length of mail compartment.	Length of passenger compartment.
	combined	14′ 5″	...	23′ 3″
	combined	11′ 10″	...	25′ 10″
	combined	17′ 0 3/32″	...	20′ 8″
	combined	17′ 0 3/32″	...	20′ 8″
	combined	11′ 10 3/32″	...	25′ 10″
	combined	11′ 10″	...	25′ 10″
	combined	14′ 6″	...	24′ 9″
	combined	20′ 10″	...	18′ 4″
	combined	13′ 1″	...	26′ 1″
	combined	21′ 7″	...	28′ 8″
	combined	26′ 7″	...	23′ 6″
	11′ 7″	9′ 5″	...	34′ 2 1/2″
	11′ 7″	9′ 5″	...	34′ 2 1/2″
	combined	26′ 3″	...	23′ 11″
Pennsylvania	combined	26′ 7″	...	23′ 7″
	11′ 7″	17′ 6″	...	24′
	13′ 8″	10′ 3″	...	44′ 7″
	13′ 8″	10′ 3″	...	44′ 7″
	13′ 8″	10′ 3″	...	44′ 7″
	13′ 8″	15′ 9″	...	39′ 1″
	14′	32′ 3″	...	22′ 3″
	14′	10′ 3″	...	44′ 3″
	14′	15′ 9″	...	38′ 9″
	13′ 10″	10′ 5″	...	44′ 3″
	13′ 10″	18′ 8″	...	36′
	13′ 10″	21′ 5″	...	33′ 3″
	17′ 6″	9′ 6″	...	41′ 6″
	17′ 6″	9′ 6″	...	41′ 6″
	13′	16′ 6 1/2″	...	38′ 9 7/8″
Pittsburgh, Lisbon & Weston .	...	combined 21′	...	16′
Pittsburg, Shawmut & Northern	combined	18′ 8″	...	20′ 4″
	combined	18′ 8″	...	20′ 4″
	...	19′ 3″	...	17′ 9 1/2″
	13′ 2″	10′	...	36′ 7″
	13′ 2″	10′ 11 1/2″	10′ 1″	21′ 7 1/2″
	14′ 10″	13′ 11 1/2″	15′ 2″	22′ 7″
	14′ 6″	14′ 4 1/2″	15′ 2″	22′
	17′ 6″	14′ 0 1/2″	15′ 2″	19′ 9″
Reading	17′ 6″	22′ 3 1/2″	15′ 2″	11′ 6″
	15′ 10″	21′ 2 1/2″	15′ 2″	14′ 4″
	15′ 11″	14′ 4 3/4″	...	36′ 3″
	15′ 11″	14′ 4 3/4″	...	36′ 3″
	15′ 10″	21′ 2 1/2″	15′ 2″	14′ 4″
	15′ 10″	12′ 11 1/2″	15′ 2″	22′ 7″
	17′ 6″	19′ 6 1/2″	15′ 2″	14′ 4″
Richmond, Fredericksburg & Potomac	15′ 10″	26′ 2″	...	26′ 10″
	15′ 10″	26′ 2″	...	26′ 10″
	13′ 10″	30′	...	20′ 5″
	13′ 2″	44′ 9″	15′ 1″	...
	13′ 2″	44′ 9″	15′ 1″	...
Seaboard Air Line	13′ 2″	44′ 9″	15′ 1″	...
	13′ 2″	59′ 10″	...	...
	13′ 2″	59′ 10″	...	...
	10′ 0 1/2″	61′ 11 1/2″	...	...

RAILROAD.	Length of engine compartment.	Length of baggage compartment.	Length of mail compartment.	Length of passenger compartment.
Southern Pacific	15′	12′ 1″	...	41′ 4″
	15′ 10″	14′ 0 7/8″	...	36′ 6 1/2″
	16′ 3 5/8″	20′ 3 5/8″	...	31′
	15′ 10″	...	...	45′ 4″
Southern Pacific-Texas and Louisiana Lines	12′ 9″	40′	15′ 2″	...
	12′ 6″	41′ 5″	15′ 2″	...
	13′ 3 1/8″	41′ 9″	15′ 2″	...
	12′ 8 1/2″	45′ 11″	15′ 2″	...
	16′ 3 5/8″	41′ 9″	15′ 2″	...
St. Louis-San Francisco	8′ 3 1/4″	7′ 9″	...	35′
	11′ 11″	9′ 5″	...	34′
	10′ 2″	...	...	48′ 4″
	15′ 10″	40′ 4″	15′ 2″	...
St. Louis Southwestern	combined	17′ 0 3/16″	...	20′ 11 13/16″
	combined	13′ 5″	...	19′ 5″
Temiskaming & Northern Ontario	11′ 2 1/8″	16′	...	39′ 4 1/8″
Tonopah & Tidewater	10′ 0 1/2″	28′ 11″	...	20′ 5″
Toronto, Hamilton & Buffalo	10′ 0 1/2″	16′ 7″	...	29′ 2″
Union Pacific System	13′ 8″	...	...	38′ 2″
	13′ 8″	24′ 10″	...	28′
	14′ 1″	16′ 9″	...	36′ 1″
	19′ 4″	...	...	39′ 6″
	10′ 1″	...	...	52′ 6″
	10′ 1″	...	...	52′ 6″
	10′ 1″	22′ 6″	15′ 2″	20′ 5″
	10′ 1″	28′ 11″	...	29′ 2″
	16′ 3″	38′ 3″	15′	...
	11′ 8″	...	...	52′ 3″
	11′ 11″	23′ 1″	...	33′ 4″
	10′ 1″	25′ 5″	15′ 2″	17′ 6″
	16′ 3″	37′ 10″	15′	...
	13′ 8″	24′ 10″	...	28′
	11′ 11″	...	...	53′ 6″
Wabash	8′ 3 1/4″	49′ 0 3/4″	...	...
	8′ 3 1/4″	25′ 8 3/4″	...	17′ 6″
Wheeling & Lake Erie	13′ 2″	...	...	42′ 8″
	13′ 2″	14′ 1″	15′ 1″	13′ 6″
	13′ 2″	14′ 1″	15′ 1″	13′ 6″
Wichita Valley	15′ 9 5/8″	44′ 0 3/8″	15′ 2″	...

The cost of the stainless steel is very high, approximately 40 cents per pound; however, due to the fact that a relatively small quantity is used in a car, that it has a high degree of ductility, may be readily rolled into the necessary structural shapes, is highly resistant to fatigue, is practically non-corrosive and requires

no protective coating, it has been advantageously used. It is to be hoped that the cost of this metal will be reduced. The « Shotweld » process as developed and patented by the Budd Company seems to have been fairly successful with stainless steel and is well worth a careful study by those interested in light-weight construction. Its broadest use is in permanently securing to each other plates set face to face, and the designs of members and connections are made to permit of rapid and effective shotwelding. The process consists of passing a current of low voltage and high amperage through the plates between copper electrodes pressed firmly against each outer side. The passage of the current causes a fusion of the metal of the faces in contact over any desired area not greater than that of the electrode points. The welds in body construction are usually about 3/16 inch in diameter. The pressure, volume of current and time of application are accurately controlled to prevent fusion extending to the outer surfaces of the plates. In practice fusion is not permitted to extend further from the inner contact surfaces than about halfway through the plates. The time the current is allowed to flow is almost infinitesimally short and, as a consequence, the temperature of the outer faces is not raised above the point of reducing the non-corrosive properties of the metal, either in the weld or the adjacent metal.

It is in this latter feature of assuring protection of the weld that shotwelding is distinguished from spotwelding, and the distinction is an extremely important one, especially in the joining of the thin sections necessary to produce light-weight structures. The life of any structure built of thin steel and exposed to the elements is in considerable degree dependent upon the ability of the metal to resist corrosion. If the metal is not resistant to corrosion, and if the welds are unprotected, or unprotectable, as may readily be the case in spotwelded connections, the danger of deterioration calls for a design requiring greater thicknesses of parts, and correspondingly greater weights than would otherwise be the case, to allow for wastage.

Shotwelding may be done automatically or by hand. The welds may be made with great rapidity under conditions of control that assure uniformity of strength, accuracy of position and, in the case of stainless steel, without reducing the ability of the metal to resist corrosion.

The development of steels more suitable for modern electric arc welding offers some possibilities. Spot and butt welding are as yet comparatively limited in their application to light-weight car construction. The oxy-acetylene process is used in some instances, but the modern electric arc-welding methods with their comparative freedom from heat expansion seem to be much more widely used.

Many of those reporting indicate a preference for some form of automatic electric welding with high-strength steels that lend themselves to the welding practice; others indicate a preference for aluminum alloy construction.

Maintenance.

In connection with the design and construction of the frame and body it is essential that due provision be made for efficient and low cost maintenance of rail motor equipment, whether the power equipment be in motor cars, articulated trains or locomotives or power units, since there is every indication that we will eventually have all forms in operation in the same territories or sections. Because of construction standardization not yet definitely crystallized, it is difficult to discuss in detail the entire problem of construction as related to maintenance. However, there are some lines of repair work so basic that construction of vehicles must

be carried out to fit into the scheme if maintenance costs are to be kept to a minimum.

In dealing with these problems we must consider three classes of repair work :

a) Heavy repairs performed at shops;

b) Running repairs made at terminals;

c) Emergency repairs made out on the road.

For general repair work, power trucks and others must be removed from diesel locomotives and streamlined trains. Shops equipped with cranes of sufficient capacity to lift such vehicles may be used in handling unattached units, if provision has been made in design of the vehicle's understructure to carry the load. The underframe of diesel locomotives should be so designed that lifting brackets of the crane can be attached at the sides of the underframe at points on a line with the center castings.

Streamlined trains of the articulated type cannot be handled in this manner when attached — and disconnecting is bound to run up costs. Nevertheless streamlined cars, articulated type or otherwise, should have provision made for crane lifting or jacking pads at proper locations, to be described later.

The least costly method to remove trucks — both from the standpoint of first costs and those incurred in making repairs — is to install a platform top drop pit table. These drop pit tables can drop at one time complete six or even eight-wheel trucks, as they are made in capacities up to 80 tons, and have distances across the drop pit as high as 24 feet. Their pits for this particular work can be made shallow as a drop of less than 2 feet will allow the trucks being removed to clear the body of the locomotive or car.

The drop pit table equipped with a platform top and rails is the ideal machine for changing trucks, and is especially needed for truck changing on articulated type streamlined trains.

When trucks are being lowered, the vehicle must be supported and it is highly important that jacking pads at proper locations be considered when designing locomotives or cars powered by diesel engines. Besides the customary jacking pads located at each end of the locomotive, additional pads should be located on each side of the locomotive just behind the trucks, so that locomotives undergoing repairs may be supported at the side walls of the drop pit, either in front or behind the truck during truck dropping operations.

Streamlined cars in all cases should have jacking pads placed at the sides of the cars behind each truck, even though packing pads are considered for each corner of the car. This is particularly important on the articulated type trains.

Wherever possible, all jacking pads should be spaced sufficiently apart that when the vehicle is supported at these locations, trucks may be rolled ahead or backward without the journal boxes striking the supporting jacks or blocking.

On articulated type streamlined trains, if jacking pads are not desired, the car's understructure should be so designed that it may safely take the load behind the truck when resting on a cradle at the side wall of the drop pit — a cradle having the same contour as the bottom of the car at the point of contact.

Running repairs must be considered at terminals. Trucks may require but little work. Nevertheless, spring rigging work frequently occurs and single pairs of wheels must be frequently removed because of the usual defects. Terminals handling diesel locomotives and streamlined trains should be equipped with platform top drop pit tables designed to handle single pairs of wheels, with or without their motors. Pit depth should be such that the wheels being removed

should clear their truck frames, and a width sufficient to handle a pair of wheels with or without motors. Such tables should have a lift 5 inches above approach rails for satisfactorily making spring rigging and other repairs.

Jacking pad locations, as previously mentioned, are necessary for doing this terminal work.

This brings us to an important requirement to which insufficient consideration has been given, in some previous designs of motored vehicles. The motors driving the wheels by means of gears have housings equipped with bearings contacting with truck axles. These bearings are split, and after the outer housing bearing is removed, the pair of wheels cannot be dropped, because of interference from the axle bearing of the motor housing. The interference is caused by the angle in which the split is made from a vertical plane.

Before wheels may be lowered, it is necessary to roll the wheels ahead from 4 to 6 inches to clear the motor pinion and this interfering bearing. This forward movement cannot be accomplished with journal boxes operating in the conventional pedestals.

To overcome this difficulty, some roads have thick demountable shoes placed between one side of the journal and its pedestal. When dropping wheels without the motor, the rods or binders are first removed, and shoes removed. Wheels are rolled ahead sufficient to clear the motor housing bearing and then lowered and released.

A pair of wheels and its motor may be readily lowered on one of these tables for making both wheel or motor repairs. This procedure eliminates the necessity for raising the vehicle and rolling out a complete truck. The truck design, however, must be such that no permanent obstructions be placed below the motor and its housing.

Out on the road the trucks and wheels of diesel-electric equipment will present no more obstacles than confronted with in the use of steam locomotives and cars. Procedures practical for one would be applicable to the other. Improved design and rigid inspection have eliminated most of delays on the road. As burnt journals or bearings constitute the greatest trouble, it might be well to consider the use of an auxiliary or emergency bearing for substitution when bearings have seized or become defective.

Without proper attention to proper locations of jacking pads, understructure construction for resting on cradles at fixed points and use of pedestal shoes for wheel and truck changing, maintenance costs are bound to run up and reduce the operative gains made possible through the use of diesel-electric equipment. Locomotives and trains of this type already have been constructed that are perplexing those in charge of maintenance, because of the builders not giving repair facilities sufficient consideration.

With the growing use of diesel equipment, spare engines ready for service will be kept in reserve. When changing these engines, they can be best handled by a raising movement from their beds. On some designs of cabs, the cabs may be removed entirely to obtain sufficient movement for making the change. Where this construction is not possible, means should be provided for lifting the engines through a specially designed roof.

The diesel engine requires running repairs, and parts requiring inspection and attention should be accessible, with ample room for doing the necessary work.

The same holds true for the generators, compressors, heating and air-conditioning equipments, air brakes, lighting and controls. Few designers give sufficient attention to the locating of parts for obtaining low maintenance costs, concentrating largely on the en-

gineering angle, with some consideration devoted to the problem of convenient operation.

The excuse might be offered that the designer is restricted by space. This is probably true, but this condition also exists on the steam locomotive. Nevertheless, designers, through the cooperation of motive department officials conquered these important problems, and most equipment on the modern steam locomotive is now located not alone for handy operation, but also for accessibility in making repairs.

Designers of diesel locomotives and streamlined trains could well seriously consider co-operating with practical railroad officers in charge of locomotives and cars. We stress this point, because one of the governing factors of increased use of motorized equipment will hinge on maintenance costs — and the manufacturer whose equipment has the best maintenance advantages, will have such equipment most favored, with other factors remaining the same.

On the use of multiple vehicles we believe that the trend will follow the evolution of the automobile trailer used in the trucking industry. First, a four-wheel trailer, and last, a semi-trailer attached to a powerful tractor.

The articulated train has the advantage of using a single truck to support the ends of two connected cars. Weight is reduced and costs lowered, because of this design. The disadvantage is the difficulty in applying additional cars and removing them as traffic requires.

Articulated trains, as presently constructed, can only be separated at the expense of considerable labor and time, and then, only at terminals where facilities are available. Unless the disconnected car is placed on another truck, it cannot be moved.

It has been said that articulated trains are supposed to be thus connected — permanent in their connections — unless shop work required separation. This is no doubt true, but the main objection voiced by transportation departments would be eliminated if some of the general ideas of the semi-trailer were incorporated.

It would be to the advantage of someone to design a practical arrangement for articulated cars, whereby cars might be disconnected more readily and switched on a wheeled device used only to support the end of the car temporarily, not equipped with a truck. This, of course, would call for a more simplified connection between car bodies at their ends for passage of passengers through cars.

The advantages of articulation from the standpoint of high-speed riding qualities, less weight, lower operating and maintenance costs and more simple design, should favor increased popularity, that would be still greater enhanced, if, in addition, they could be constructed for more ready attaching or detaching, in case occasions might call for additional cars, or defective sections require cutting-out, so as to replace and continue the train in service.

In a study of the design, construction and operation of light-weight, high-speed trains, it is well to take into consideration the kind or class of track over which the equipment in question will run.

It has been quite well established that a train of the low center of gravity, articulated type can be operated with safety and comfort to passengers at considerably higher speed than a train of conventional type, especially so if the track be of a second class as compared to the best track. This is a very important factor since there is a marked difference in the maintenance as well as the first cost between these two classes of track.

Another factor that should not be lost

sight of when calculating weights and speeds, is that of signaling. For example:

The modern light-weight, high-speed train with modern brakes can be stopped in the same distance when running 90 miles per hour as can the conventional steam train running 60 miles per hour with standard conventional brake (service stop).

Special remarks.

Practically all railroads reporting advise that they either have standard couplers on their motor cars, or carry a bar adapter with an eye in each end on the car, that may be used to couple into a socket, coupler or drawbar head (hidden behind the shield in streamlined trains, a shutter opening when desired to use) by use of a coupling pin, when necessary to couple to standard cars or locomotives, the other end of the bar fitting into a special knuckle, also carried on the car, with a coupling pin, the knuckle being put in the place of the regular knuckle removed from the standard coupler.

The foregoing refers to American railroads using standard A. A. R. couplers — no other countries reporting. The buffing therefore is accomplished by the regular draft rigging.

Body insulation as a protection against asmospheric conditions.

Some of the roads are using a 1/2-inch thick layer of hair felt placed between two layers of 80-pound Craft paper, the outer of which is cemented to the inner side of the outer sheathing or belly sheet under the floor to insulate against both noise and atmospheric conditions, « Alfol » being used as the main insulating medium. Alfol is made of the purest aluminum, rolled into sheets of extreme thinness and depends upon its reflective capacity to retard heat transfer. In its application the sheets are deliberately crumpled and the resulting ridges act as spacers to separate the various layers and to oppose heat and sound transmission.

Four layers of Alfol are applied to the sides, ends and roofs. The floor covering helps the hair felt insulation in the underneath sheathing. Cork filler is placed in the recesses of the corrugated steel floor, and on top there is a 5/16-inch layer of cork.

In the baggage and mail compartments, the cork layer is overlaid with maple flooring.

In cars built with stainless steel, the structure and sheathing itself is an insulating medium when compared to a car built of carbon steel, or any other metal having a decidedly higher heat conductivity, the heat conductivity of stainless steel being one third that of carbon steel.

Other roads use the same underneath the floor insulation and 5/16-inch cork floor covering, but use a 2-inch blanket of « Dry-Zero » in the side walls, ends and roofs.

Still other roads use two inches of « Rokflos » throughout the train as an insulator against both heat and sound with Magnesite, a composition flooring with cork tile.

The American railroads have depended primarily on their experience with steel cars to guide them in the selection of insulating materials and their applications; however, the light weight design largely influenced the use of Alfol.

Special features intended to increase the passengers' comfort and safety.

Outside noises have been practically prevented from reaching the passenger compartments by the adaption of air-conditioning, at the same time shutting out dirt, dust and odors; simultaneously engine room noises have been prevented from reaching the passenger compartments.

With electric transmissions, there has been but little trouble from transmission vibration. The vibration from mechanical transmissions proved troublesome when long propeller shafts were used, otherwise in a reasonably well designed car, they were not serious.

Engine vibrations, especially with engines of the higher speeds, unless the engines had been carefully balanced and counter-balanced, and air compressor vibrations, have presented and still are presenting a problem.

Spring mounting, rubber supports and various kinds of vibration deadeners have been tried with varying degrees of success. The most practical design so far, seems to, wherever possible, isolate the engine from the passenger compartments; (*a*) in an articulated train, by having nothing but mail, express, baggage, etc., compartments in the section of the train containing the power plant; (*b*) in motor trains not articulated, by carrying passengers in trailer cars, with only mail, express, baggage, etc., in motor cars; (*c*) in single motor cars, by using vibration deadeners or absorbers to insulate the engine, air compressor, and transmission frames, etc., from the car framing and body, with as flexible drive shaft and gear as possible, to connect to the driving axle, in the case of mechanical transmissions. In the case of electric transmissions, the problem is made somewhat easier by the elimination of the direct metal drive.

One of the most difficult problems seems to be the prevention of vibrations following the metal piping. Flexible hose insertions in the metal lines have proven quite successful.

The same design and materials used in the body for heat and cold insulation serve also to deaden or shut out undesired sounds or noises.

Rubber pads are inserted at numerous contact points in the trucks and between the trucks and the body of the car.

Various forms of pads have been used and most of the large rubber companies now have specially prepared materials which they offer for the several contact points.

In the United States where the air conditioning of practically all passenger-carrying cars now in use is being rapidly completed, and all new cars are having air conditioning equipment built in while undergoing construction. It is a comparatively easy matter to eliminate all of the unpleasant features occasioned by uncomfortable temperatures, dirt, smoke, odors and noise, that originate on the outside of the car body, and to at the same time remove any objectionable odors that may originate within the car. Experience seems to indicate that air conditioning (with all that the name implies), is justified for insuring cleanliness and freedom from odors, even though the temperature would have been comfortable without it.

Streamlining and light-weight design calls for flush outer surfaces, which together in their turn call for window and door designs that have tight fits.

As a general practice the windows of flush design are glazed with double hermetically-sealed units, preferably using two pieces of 1/4-inch Safety shatter-proof glass having 1/4-inch dry air space between. Thus not only is temperature insulation secured, but frost and condensation are prevented from forming, and clear vision is always afforded the passenger. « Duplate » glass excluding a part of the light frequencies in the solar spectrum, to keep out sunlight glare, is largely used. Safety glass is not as yet required by law on the American railroads.

Doors with tight fits, some swing and some automatic inset, with mechanism both manually and pneumatically operated, are used in connection with fold-up bottom steps and step wells closed by trap doors.

The American railroads in practically

all cases have built all of their trains, both articulated and non-articulated, so that the passengers can pass freely and with comfort and safety from one passenger section or car to another, and with doors of suitable design for the safe passing of trainmen through the entire train not including the steam locomotive, but including the motor car of motor trains.

As yet the outer doors of the cars are handled at the discretion of the trainmen, the engineman having no control over them, nor has any signal system yet been devised; all indications however, point to such arrangements eventually, in the interest of safety. Some feel that only small sliding windows for signaling should be openable when the train is running at high speed.

There have been no laws enacted governing the seating, since it is generally felt that the desire on the part of the railroads to attract passengers guarantees design and development for passenger comfort.

Seating comfort has been given much detailed study by both the traffic and engineering departments.

Likewise, every endeavor is being made to provide clean comfortable toilets, (water-flush type), lavatories, smoking and lounge compartments for both men and women.

Post Office requirements are met in practically the same manner as they were met on the conventional steam trains. Such facilities must, in the United States, be approved by the United States Postal Authorities.

Luggage or baggage compartments are practically the same as those of the conventional steam train, except in the case of the few small motor cars in service, in which the facilities are practically the same as in the large United States highway passenger buses.

Before streamlined trains were built in America, the Union Pacific Railroad, the Burlington Railroad, the Pullman Company, the Edward G. Budd Company, the University of Michigan, the Massachusetts Institute of Technology and others made wind-tunnel tests of models and gave much study to the problem of air resistance and air drag.

Several months of intensive research work resulted in the rejection of several preliminary assumptions, especially as regards ratio of length to cross section and the element of ground drag, some of the imposed conditions being quite different from those in aeronautical work.

Without these tests, the streamlined design could not have been so readily developed.

The Union Pacific and Pullman Company making use of extruded aluminum alloy shapes and plates, developed a car of tubular section, the inner surfaces of aluminum sheets, the frame of extruded aluminum sections. All of the metal in the framing being co-ordinated to act as a unit, whether for draft or buff, as it is impossible to deflect or stress any member without having adjacent members bear their portion of the strain. This differs from the ordinary form of car design, in which draft or buffing shocks are taken care of by longitudinal underframe members. To provide for the hazard of grade-crossing collisions with highway vehicles, the nose of the front car is built out from the heavy engine base in the form of structural members which make a strong parabolic arch.

The trucks are shrouded and flexible shields cover the gaps between the car units.

The Burlington, the Edward G. Budd Company and the New York, New Haven and Hartford are making use of the Budd form of truss construction, which employs built-up sections of their gage stainless steel. The truss members of box sections are formed of deep flanged channels and cover plates. The fabrication of the members themselves, and

of the members to each other and to connecting plates is by shotwelding, explained elsewhere in this report.

The engine bed at the forward end of the first car is a fabricated structure of high-tensile strength steel alloy plates, cut to shape and arc-welded together to form the bumper, engine bed and bolster.

At the extreme front of the engine room is a strong collision post, sharply inclined from the vertical, around which and the curved forward part of the engine bed is formed the front end of the car.

The ends of each pair of adjacent cars or sections are articulated and connected by a swivel joint supported on the truck. The articulation castings are firmly secured to the end framework of the car and from these extend arms which provide for side-bearing thrusts.

The floor and roof structures are of corrugated stainless steel sheets, the former shotwelded to plain sheets and through these to the stringers, the latter directly to the roof members.

The exterior curved surfaces at the front and rear are covered with plain stainless steel sheathing, thick sheets being used at the front end and thin sheets at the rear. The exterior side walls are sheathed with thin sheets artistically fluted and shotwelded to the frames.

The space under the car between the trucks is enclosed with corrugated sheets and provides space for accessory equipment.

Heating and ventilation.

There are three general classes of rail motor car service :

1. Branch line local.
2. Main line local.
3. Main line through.

Within the last few years, transport conditions have changed so rapidly that while we still have conventional or old-type passenger trains in the great majority, we cannot be said to have any one standard so far as the United States are concerned (on account of the wide use of automobiles on our highways).

It looks very much as if the branch-line local passenger train is almost a thing of the past; however, when there is enough business to justify it, a light-weight rail motor car, with or without trailers, capable of fairly high speed, with facilities for reasonable comfort and low operating cost, seems to be best adapted.

The main-line local motor train should partake of the same general specification as the main-line through motor train, except that it would be smaller in total capacity, and not so elaborately equipped for passenger comfort, that is the same comfort should be afforded without the frills.

The main-line through motor train that is proving most satisfactory seems to be the light-weight, streamlined high-speed diesel-electric air-conditioned one. Whether or not the majority of these trains will be articulated or non-articulated remains to be seen.

As previously stated, air conditioning is an important factor for several reasons, and therefore windows are not designed for opening in air-conditioned cars.

The maximum summer temperature in the shade is probably 115° F., with sometimes a high humidity.

Some advocate a difference of 15° F. between outside and inside temperatures, but not lower than 70° F. at any time within the car.

Pullman mechanical, York, Safety Carrier, and Ice activated air-conditioning systems are being quite extensively used. Frigidaire, General Electric, Westinghouse and some others are also in service, and practically all of them are giving a good account of themselves. The art is still new and we may expect much improvement in the future.

Depending upon the type or system used, the power requirement varies from 2 to 6 H.P. for a 60-70 foot passenger section or car. The refrigerating capacity varies from 1 1/2 to 5 1/2 tons.

Generally the fresh air is mixed with the recirculated air in the proportion of 1 : 5, the air being completely recirculated every 1 1/2 minutes as a rule.

It must be understood that there is quite a large range in air conditioning requirements, depending largely on the weather conditions encountered, and the habits and demands of the traveling public.

The subjects of heating and ventilation may today be classed or considered as divisions of air conditioning when planning for new and modern equipment, or when planning on reconditioning and modernizing old equipment.

In America steam heating (steam from locomotive), became practically standard for railway passenger train cars including mail, baggage and express as well as passenger cars, some years ago.

With the advent of the internal-combustion engine or rail motor car, hot-water heating again came into use and, some four or five years ago, the automatic steam heating plant built into a motor car or motor train.

A study of the data collected is interesting, indicating as it does that our heating developments have almost failed to keep pace with our cooling developments during recent years.

A brief description of some of the most recent heating developments for motor trains is included hereafter.

The Vapor Car Heating and Lighting Company have supplied quite a few Peter Smith automatically-operated steam heating boilers for installation in motor cars or baggage cars operated in motor trains. These boilers supply steam to the steam heating mains of the cars to be heated in a manner similar to that followed in heating passenger train cars with steam from steam locomotives.

These boilers are of oil-fired type with an evaporative capacity of 250 pounds, 500 pounds, 750 pounds, 1 000 pounds per hour or more, depending on the size as manufactured, the pressure depending upon the length of the steam line run and size of boiler.

For example :

A boiler of 500-lb. per hour capacity, at 85-lb. pressure, is used for a 200-foot articulated three-car train running where cold winters are the rule.

The oil burner motor and the feed-water pump motor are both automatically controlled by steam pressure and water level respectively, through an electrical arrangement; an ingenious method of installing three vertical-contact electrodes each of different elevation as regards the water line, in the water column (they somewhat resemble spark plugs where they pass through the head or wall of the column), made the control of the water level exceedingly easy. The entire equipment is so designed as to fail only on the side of safety and it is very reliable in operation.

The boiler has a large number of small copper tubes set vertically in the heads.

The fuel burned is practically the same as that burned in distillate or diesel rail engines and is in most cases taken from a fuel tank common to both the engine and the boiler.

In some installations (in the case of short trains), the condensate from the overhead radiators, used in connection with air conditioning, is drained into a tank or sump from which it drains back to the boiler water supply tank near the boiler, thus somewhat reducing the quantity of feed water it is necessary to carry.

The heating plant consisting of a 500-lb. boiler with all necessary equipment ready for operation in a 200-foot 3-car

articulated train operating under severe winter conditions weighs 5 350 lb. of which 2 850 lb. is required for the water supply.

A 3-car standard or conventional American type railway train requires approximately double this equipment in capacity and weight when hauled by a rail motor power unit. The heating plant with water and fuel was installed in the power unit and has been very successfully operated.

Eight motor trains of this type have been in operation during the past four years. The Burlington 3-car « Zephyr » train heating system is equipped with a Vapor Company's Peter Smith automatic oil-fired boiler having an evaporative capacity of 500 lb. of water per hour at 100-lb. pressure. Condensation from the system drains into sump tanks in each car, and from there is automatically returned to a 50-gallon feedwater storage tank instead of being discharged into the atmosphere, as is the usual practice, with an air duct carried throughout the train on each side below the floor line, and there is also a central ceiling duct, these ducts being connected between the cars by flexible bellows. Heat is obtained by passing air through the radiators of the engine, this air being forced by blowers through the floor ducts, there being an outlet at each seat. Air is exhausted through openings in the ceiling duct. Two oil-fired, hot-air furnaces, supplied by the Vapor Car Heating and Lighting Company, are installed in the baggage compartment. They are used to heat the cars at terminals and in the yards when the engine is not running, and can also be used for emergency, should there be a failure of the heat from the engine radiator. These furnaces are provided with motor-driven pumps and fans and electric ignition. The burners are designed to operate with either D. C. or A. C. power and, in the former case, have windings which generate alternating current, stepped up by a transformer to approximately 10 000 volts for ignition purposes. Thermostats control the heating in the cars by operating motorized dampers controlling the heat from the engine radiator, or by controlling the operation of the oil burners.

An interesting air conditioning system, designed by the Pullman Company especially for articulated streamlined trains and which is used in the Union Pacific 6-car train just now going into service is herewith briefly described :

A Frigidaire system as installed in this train, in the sleeping cars and rear coach-buffet car, is furnished with cooled air distributed through the cars by means of the ceiling duct which has outlets through the grilles and is returned to the air-conditioning compartment, through the underfloor ducts on each side of the car.

The entire train of six cars, except the power car, is heated by means of hot air forced through underfloor ducts, one on each side of the car, and connected between cars, where required, by flexible bellows. The ducts have outlets into the car though grilles in the wainscoting and window capping. Air is returned to the heating generators through a ceiling duct on the center line of the cars, where it is mixed with fresh air brought into the system from the outside of the cars.

One heating unit consisting of an oil-burning hot-air generating unit is located in the front end of the second or baggage-mail car. This unit supplies heat for the baggage and mail compartments of this car only. One air-conditioning unit, located in the rear end of the second car, consists of two hot-air generating furnaces and two 5-ton refrigerating compressors, with the necessary blowers and apparatus for furnishing conditioned air to the third and fourth cars which are Pullman sleepers. A similar unit is located in a compartment in the rear end of the fifth car, to

furnish conditioned air to the fifth car which is a Pullman sleeper, and to the rear buffet coach.

Ventilation of the baggage-mail car is furnished by streamlined exhaust ventilators in the roof, and ventilators in the bottom window-sash rail. The blowers in the heating unit can also be operated, if desired, to supply fresh air to these compartments in summer. The toilet rooms have streamlined exhaust ventilators in the roof. The air-conditioning systems for the passenger-carrying cars are under thermostatic control. A thermostat in the main compartment controls the heater for the baggage-mail car. The engineman's cab in the front end of the power car is equipped with a hot-water heater, taking hot water from the main engine jacket. The heat in all of the modern trains is controlled automatically by thermostats.

One of the latest developments but one which has not yet been tested in service, consists of an individual car heating plant to be used in connection with air conditioning. This plant consists of an automatically-controlled oil-fired air heating furnace with necessary blowers and control, for supplying the heated and conditioned air to the distributing ducts. The automatic controls are all electric. The current is obtained from the same source of supply as that which furnishes current for lighting, air conditioning motors, etc.

Practically all steam-heated motor trains have their equipment so designed that the trains can be heated with steam from a roadside steam plant or supply at terminals and lay-over points. This avoids the difficulties encountered, including the danger of, or liability to, freezing up, such as are common when completely drawing hurriedly from a system in severe cold weather. (In case of removal from service for storage, drain plugs are usually removed to guarantee against freezing. This, however, requires time.)

By keeping the cars warm during lay-overs, the interior finish and trim is not so liable to be injured by frequent extremes of temperature, and the question of time for heating the train before going out on its run is not involved.

It is difficult to start up a heating plant during cold weather and the economy of the method of drawing and heating is doubtful.

As a rule, two hours in the most severe weather is sufficient time for heating a cold train, but there is always the chance that something wrong will show up to cause trouble and delay and probably expense.

All of the modern trains have either an ample source of electric current supply, whether running or standing, or arrangements are made in terminals for plugging into a roadside source of supply.

The railroads reporting indicate that there is no one-standard for air supply to brake and control systems.

Some roads use a 75 cu.-foot air compressor directly driven from the main engine shaft with an auxiliary 25 cu.-foot motor driven compressor, driven from a bus common to a 35-kw., D. C., 76-volt generator (V belt driven from main engine), and a 64-volt, 450 ampere-hours storage battery. The generator supplies constant voltage at all engine speeds, from idling to full speed.

This power arrangement also supplies current for air-conditioning, and heating motors, lighting, control devices, etc.

Other roads use the same general arrangement but use smaller-capacity main compressors and auxiliary generators.

Still other roads use two 25 cu.-foot motor driven air-compressors driven either from the main generator or from an auxiliary engine-driven generator.

Some depend on a single 50 cu.-foot motor-driven compressor, others two 35 cu.-foot motor-driven compressors.

From all indications, it seems proba-

ble that the arrangement of a large compressor driven directly from the main engine shaft and a small auxiliary compressor motor driven from a bus common to a suitable, say 25 to 40-kw. D. C. 76-volt generator (driven directly from main engine shaft) and a suitable, say 450 to 650 ampere-hours 64-volt battery will prove to be the most satisfactory, when the problem is considered from all angles.

The compressors reported are all of the reciprocating type, most of them General Electric and Westinghouse, when motor driven, Gardner-Denver or Westinghouse when directly driven from engine shaft.

The governors for the compressors or pumps are as a rule General Electric or Westinghouse for the motor-driven compressors. Those for the mechanically-driven compressors are Westinghouse, or one furnished by the compressor builder.

Pressures are practically the same as those standard for conventional passenger trains in high-speed service.

Mechanically-driven pumps and motor-driven pumps with very few exceptions unload or stop at maximum pressure, with the starting range similar to that used on electric railways.

Rail motor car brake systems are in practically all cases of such design and of sufficient capacity to supply braking power to all the trailers the motor can haul.

Batteries used in motor cars cover a wide range in size and capacity, depending on the type of car or motor train and the service in which they are operated, for example :

Size of motor car.	*Capacity of battery.*
up to 150 H.P. . . .	40-80 ampere-hours
150 to 250 » . . .	80-150 » »
250 to 400 » . . .	150-300 » »
400 to 600 » . . .	300-450 » »
600 to 800 » . . .	450-700 » »

Most of the batteries are of the lead-acid type in rubber jars, the majority of Exide Company's Ironclad type and some of the regular pasted type. The number of cells depends on the voltage, as for example, 16 cells—32 volts, are used on smaller cars and smaller batteries, 32 cells—64 volts are used on larger cars and larger batteries.

Some nickel-iron batteries are used.

As a rule the batteries are placed in specially arranged battery boxes either under the car or in shelves inside the car. In either case the boxes or shelves are well ventilated and the wooden trap containing the cells are blocked in to prevent their being shifted or moved around by the car or train movement.

Cell covers and vents are designed to prevent sloppage or spillage, yet permitting free venting of gas. The intercell and battery connectors are as a rule « burned on » to prevent gas ignition.

The load varies with the size and design of the car or train, and the service in which operated, air-conditioning equipment when installed furnishing the major portion of the load. Next comes the engine starting load, especially in the case of diesel engines, when they are cold. The lighting load is usually of secondary importance, especially so if an auxiliary engine-driven generator is used.

In the great majority of motor cars and motor trains, the battery is floated by an automatic switch on either the main generator exciter of the smaller cars, or on the bus connection between the battery and the auxiliary generator, this automatic switch providing the necessary protection with a fused cut-out in the circuit.

Mechanically-driven motor cars have a regulator and automatic switch in the circuit between the gear- or belt-driven generator and the battery, together with a fused cut-out. In some cases the generator is of the inherent voltage regulation type.

In the earlier cars, depending on manual control, charge regulating switch,

plus floating on exciter circuit, the battery life was too short. Today the equipment is designed to float the battery at constant potential, or charging control is obtained by use of ampere-hour meters, etc. Ammeters are sometimes placed in the circuit to show charge and discharge rates, but voltmeters are seldom used.

It is seldom necessary to charge batteries from an outside source of supply; however, receptacles are provided for emergency charging.

Many of the larger mechanical terminals and passenger stations today have D. C. charging lines and receptacles with necessary cables and plugs for connecting to motor-car or passenger-car batteries. Also 220-volt A. C., lines receptacles, cables, plugs etc., of 10-K.V.A. capacity for connecting to air-conditioning motors of motor and passenger cars, for testing pre-cooling stand-by, etc.

On some motor cars and motor trains, generators are driven from the car axle, similar to steam train practice. In the more modern motor cars and motor trains, however, this practice has been abandoned.

Most of the generators in America are made by the General Electric or Westinghouse, with some Safety Car Heating and Lighting Company's equipment (especially the car-axle generators).

Practically all of the control systems depend on some form of constant potential regulation, or a modified form of same.

When the first motor cars were built in America, air starters were used for starting the engines on both mechanical and electricl transmission cars, small auxiliary engines for driving small air pumps and lighting generators being installed in the cars. The ignition was obtained from magnetos and dry cells.

With the development of the automobile electric starter, came the electric starter, and later on the battery ignition for rail motor car engines, with finally the multiple-plug battery ignition system for large engines, as developed on the Chicago, Rock Island and Pacific Railroad. At first, starters were of the 6 volt-12 volt and later 32-volt types, working off the 32-volt battery common to the field excitation, starting ignition and lighting load, with ignition tap off the 32-volt section of the 64-volt battery, such as came to be used in the larger cars. The smaller engines used one starter. The first 400-H.P. engine used two starters. Then some of the larger engines were turned out with the main generator suitably wound for this purpose.

The largest diesel engine reported for rail service to date is a 1 600-H.P., 550-r.p.m. Vee-type, with light 13 1/2-inch × 16-inch cylinders — built by the Busch-Sulzer Company for a transfer locomotive on the Illinois Central Railroad.

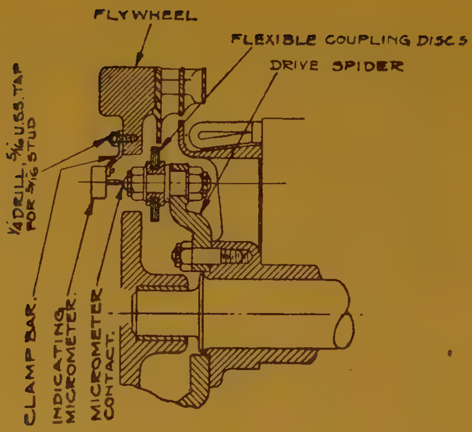
The Winton Engine Corporation have built two 1 200-H.P. 750-r.p.m. Vee type, with sixteen 8-inch × 10-inch cylinders for Union Pacific articulated, streamlined, high-speed motor trains.

The size of the individual starting motors depends upon the size of the engine, but they are all of relatively quite low horse-power and were made by such manufacturers as the North East and Leece Neville Companies. A few of the larger ones have been built by the manufacturers of the main generators and traction motors.

The first couplings between the engine and generator were of the fabric type and were unsatisfactory except for the smaller engines.

A flexible steel drive coupling was next developed and has proven to be quite satisfactory (See sketch, fig. 29).

Some manufacturers effect a coupling by having the armature shaft flanged and directly connected to a similar flange on the engine shaft, with the web of the engine flywheel interposed between the two flanges. Both engine and gene-



FLEXIBLE DISC COUPLING.

Fig. 29.

rator shaft ends are machined to fit into the fly-wheel bore, to insure concentricity and facilitate alignment. The outer end of the main generator shaft is carried on a self-aligning, non thrust type ball bearing. The inner race is pressed on the generator shaft and the outer race has a sliding fit in the main generator bearing bracket, permitting the end thrust to be taken on one of the main bearings of the crank shaft.

When ordering starters, the engine dimensions involved — gear, location for motor, size of cylinders, number of cylinders, compression, horse-power and speed — should be given, also the battery capacity.

Lighting and signalling.

In most of the motor cars and motor trains, the lighting current has been supplied from the exciter and battery bus of the main power plant for one- and two-car trains at 32 volts — for some and especially the longer trains, at 64 volts; in small mechanical transmission cars, sometimes 12 volts from the small belt or gear driven generator, sometimes 32 volts.

In the latest 6-car Union Pacific train an auxiliary generator unit consisting of a 4-cylinder 5-inch × 7-inch 2-cycle oil engine, directly connected to a 220-volt, 3-phase A. C. generator, is provided to furnish power for the auxiliaries, control, *lights*, air conditioning equipment, heaters, pumps, etc. The auxiliary engine is of the same general construction as the main engine. The electric system throughout the train uses 220-volt 3-phase current for all motors of 1/4-H.P. and over, and 32 volts for all motors under 1/4-H.P., and for all lights. Lighting circuits are laid out as a rule with panels, fuses and switches; however, some of the most recent cars have small circuit breakers (with time element), instead of fuses, and their more extended use is very probable.

Practically all circuits, both light and power, are double-wired.

Rubber insulated wires and cables of the same type as are used in electric railway equipment are practically standard. All are of a stranded construction. Conduit is used universally.

Voltage regulators are generally used, except when a constant potential auxiliary generator is used. These regulators are of the carbon-pile type.

The rear lights are controlled by simple switches such as are used for general lighting circuits.

Alarm and warning signals are of the vibrating diaphragm type.

Electric heating is practically unknown, except for an occasional local requirement and buffet ranges, that is the car body interiors are heated with hot air, hot water or steam.

Fire precautions.

Rail motor car and motor train bodies have been in the main constructed of steel and, more recently, some of them of aluminum alloy. Materials of an inflammable nature are, however, often

used for trim, partitions and upholstery. This material has not been processed for fire protection. The motor trains built recently have very little material in them that is inflammable, as a rule only the upholstery and curtains.

Exhaust pipes are lagged with asbestos covering or shrouded. Electrical circuits are always isolated from heat and fire hazard.

There is no standard rule for distances between fuel tanks and engines, and between tanks and passenger compartments.

The desire of the managements to design only safe and economic equipment, plus the skill of the engineering and operating departments, has been relied upon as the chief factor of fire prevention.

Instructions have been issued from time to time, by practically all operators, to isolate motor cars from steam locomotives as much as possible in sheds, etc., and use partitions when possible to separate the stalls or sections.

Further precautions: pits kept well drained and clean, likewise the floors, etc.; oil and fuel not permitted to accumulate; inflammable lights and torches not to be used around motor cars; all fires to be kept away from motor cars (the motor cars not to be stood over hot ashes or other fires or coals).

Smoking is generally not permitted in engine house or shop, in the vicinity of motor cars.

Before going into shops, all fuel is carefully drained from car and stored. Welding, cutting and blow torches, etc. are only to be used after precaution has been taken to prevent fire.

The electrical equipment to be carefully maintained to prevent heating or sparks from short circuits or grounds.

The maintenance of all fuel storage or fuel conveying parts to be watched very closely for prevention of leaks, also carburetors. Cleanliness must always be insisted upon.

Fuel tanks to be securely anchored and to be filled from the outside, keeping all fire and open-flame lights away; in case of gasoline to so handle as to prevent static sparks. All fuel storage and fuel conveying parts to be grounded permanently to prevent static sparks.

When on the road, smoking is permitted in the motor car including the cab or engine room. (It must be remembered that exhaust pipes sometimes operate at red heat).

Hand lanterns of the oil type, if used by trainmen, must be kept in suitable racks when they are in the engine cab or engine room.

All gasoline tanks to have safety filling and draining plugs. All fuel tanks to be of steel and designed with a high strength factor.

Safety or trigger valves, that can be operated from either engineman's seat or from outside of car, to be so installed that supply line from fuel tank can be closed in an emergency.

There are few if any automatic fire alarm signals installed in the motor cars or trains.

Portable fire extinguishers are installed in all compartments, that is engine room, mail, baggage and express, passenger, etc., in convenient locations for emergency use. Some of the two-gallon size have short length of hose and nozzle; the smaller ones as a rule have the nozzle in the discharge end of the cylinder or container.

Carbon tetrachloride types are largely used, although some foam and some methyl are used; as a rule they range in size from 2 quarts to 2 gallons.

For gasoline and distillate motor cars, two extinguishers is generally the minimum, 3 or 4 for the larger cars.

Steam motor cars and diesel motor cars, whether with electric or mechanical transmission, carry as a rule half as many extinguishers as are carried on a gasoline or distillate burning motor car of the same size, and are distributed in

practically the same way. Motor cars are not as a rule provided with other fire extinguishing apparatus than that mentioned above.

In engine houses or sheds sand buckets are usually provided.

There have been reported numerous cases in which the carbon tetrachloride extinguishers have proven their effectiveness without any ill effects to either the user or to the mechanical or electrical machinery or other parts of the equipment.

* * *

The following general information might also, in view of the present stage of the transportation art, prove interesting :

Two 6-car Corten steel, semi-streamlined trains, not articulated, one of which will be hauled by an 1 800-H.P. Winton diesel-electric locomotive, the other by a reconstructed steam locomotive, are being built by the American Car & Foundry Company, for the Baltimore & Ohio Railroad.

Two 4-car semi-streamlined, semi-light-weight trains, built at the Chicago, Milwaukee, St. Paul & Pacific Railway Company's shops, will shortly be placed in operation on a seven-hour schedule between Chicago and St. Paul-Minneapolis. Two oil-burning steam locomotives, with 84-inch wheels and 300-lb. boiler pressure, are now being built by the American Locomotive Company to haul these trains.

The Atchison, Topeka & Santa Fe company will test the possibilities in the use of a 3 600-H.P. diesel-electric locomotive, composed of two 1 800-H.P. units, in hauling the « Chief » between Chicago and Los Angeles, and is studying the advantages of light-weight equipment for various services.

The New York Central Railroad Company is engaged in experiments in the streamlining of *Hudson* type locomotives for fast passenger service.

Several railroads are now figuring on light-weight, streamlined, high-speed diesel-electric trains of the articulated type; in fact, practically all of the more important lines are conducting investigations at this time.

The tremendous increase in the use of the far-flung highways of the United States by freight-carrying highway vehicles has done much for the people as a whole. The railroads, however, have suffered and are continuing to suffer at a constantly increasing rate, a heavy loss of traffic and revenue.

At first the highway haulage took only less-than-carload freight and that for short haul, but today it is taking freight, including live stock, that formerly moved in carloads for thousand-mile hauls. The problem, therefore, has become a most serious one, especially in view of the continued demand for more and better highways and the urgent necessity for giving employment to millions of unemployed.

In view of this situation, the final or closing section of this report, under the sub-title of « Transportation », is offered in the hope that it will bring out a world-wide discussion of this important subject, so that eventually some plan will be forthcoming which will function for the good of all concerned.

Transportation.

Transportation may be termed the social medium of human relations, whether it be in goods, persons or thought. It is vital to the existence, security and contentment of the commonwealth. Transportation, the harbinger of progress, instilled in people the spirit of expectation until the demand for luxury, speed, convenience and economy has surpassed the developed physical means necessary to extend these services. The streamlined and mile-a-minute trains, highway motor freight carrier, highway

passenger bus, private motor car, aeroplane, pipe line, electric transmission line, telegraph, telephone, and radio, are progressive, constructive developments. Although electrical transmission, telephone, telegraph, radio and pipe line are not generally classified as transportation, their utilization has greatly affected the material transport agencies, not only from a standpoint of tonnage and revenue but has created a state of expectancy and demand, in goods and person movement, consistent with this era of convenience, economy and speed.

Railway travellers request lower fares, added luxury, higher speed, frequent service. Freight shippers demand higher speed, lower rates, complete service and less restrictions to classification, crating, etc. Comfort and speed must be assimilated with the highway motor bus. The air passenger demands savings in minutes of the shuttle time between business centers and airport, thus to avail himself of a service that has already reduced transit time between cities by hours and days. Truly, this is not only a new era, but an epoch of psychological revision.

It is reasonable to assume that the railways must rehabilitate their plant and service by providing passenger facilities commensurate to the speed and utility of the new forms of transport with comfort and convenience such as: Home-to-station transfer, continuous commercial telephone or radio communication en route, entertainment, stewardess service, improved solarium cars with sun bathing, exercise machines, dancing, childrens' playroom, etc. Railway travel must be a desire — not a chore.

The principal revenue producing medium of the railways being goods, or freight transport, a problem of utmost importance is presented, that is the possibility of maintaining the financial stability, not only of the railways themselves, but of the basic national institutions. Therefore, it is vitally necessary that the railways again recognize the principles upon which they were founded : the business of moving materials, or persons, for revenue. The highway motor freight carrier, extending a complete and flexible transport, has placed on the railways the burden of extending a universal, complete, high speed, flexible economical system and equipment for freight transport.

The highway motor freight carrier being a development consistent with this expectant era, has established a complete flexible service, but is limited as to the possibility of further economy in operation due to weight and size restrictions. So it becomes necessary to either build thicker or reinforced road surfaces with lower grades, larger curves and lanes assigned to freight traffic, or to coordinate, or cooperate, the highway motor freight carrier with the railroad where greater tonnage units or trains can be hauled. The possible construction of a national highway network, designed for heavier loads, or trains of trailers, of course would assist in providing a transport consistent with the demand for more economical highway hauling facilities.

As an aid to national reconstruction and security, it must be accepted, that transportation will also provide employment and opportunity for not only the present, but the younger and future generations. Transportation will not approach the zenith of economic utility until all natural resources, products of industry and field can be economically obtainable by all people in all seasons in all communities, no matter how remote.

The relative association of transportation to all phases of social and commercial rehabilitation and progress, presents the necessity for a definite means and system based on the sound « horse sense » principles of simplicity, reliability and economy, yet, fully consistent with this era of expectancy, in providing

speed, flexibility and convenience as well.

And to illustrate, such a system is herewith described, that entails these requisites, one that can be extended through coordination, or cooperation of all forms or to any one form of transport, and for convenience might be termed the *Articulated Universal Cargo Carrier System.*

Articulated universal cargo carrier system.

The articulated universal cargo carrier system is a method and means of complete and economical collection and distribution of freight, express and mail effecting coordination between existing transportation agencies and presenting the highway trailer train.

The fundamental principles of goods transport are primarily service and cost.

Freight service is divided into two classes :

Limited service, between the general receiving station of a transport agency by rail haul to its general delivery station in another community.

Complete service, rendered by a transport concern, or a co-ordination of several agencies, between the shipper's door and the receiver's door, under one billing and control.

The railways can economically provide a complete service for car load shipment where the consignor and consignee have commercial, or private, railway loading tracks at their doors.

The shipper or receiver, that does not have railway loading tracks at his door, must depend on some means of transport, other than rail, to transfer the shipment to or from the general rail receiving and delivery station. But should the railway desire to furnish a complete instead of a limited service, it must assume the responsibility from the shipper's door for pick-up and transfer, line haul, transfer and delivery to receiver's door at destination.

It would be an exceedingly simple matter for a railway to furnish a complete service for all shipments, even though, the rail haul must be supplemented by some other form of transport, if it were not essential to give the utmost consideration to the questions of the cost and speed.

The problem of the railways furnishing an efficient, economic and profitable complete freight transport service for all shipments, which are not attracted by the all-rail or carload movement, becomes a most difficult one, in the face of the continued development and growth of efficient highways, highway vehicles, and highway traffic organizations.

Some railways recognize these essentials and are extending a complete service of door to door pick-up and delivery, utilizing present standard rail equipment and contracting or operating motor carriers to do the off-rail hauling. This plan of complete traffic control is consistent with shipper demand, but the physical means employed to attain a complete movement requires the railways to pay a premium for tonnage handled. And they are still handicapped by crating requirements, terminal congestion, transfer time, excessive tare weight movement cost, off-rail costs, etc. Therefore, it is necessary, in order to furnish a complete, economical, high-speed and flexible service, to employ a type of equipment designed to meet these conditions.

It is necessary to perfect the essential mechanical devices or vehicles before a new method or system can be developed. Such devices or vehicles must of economic necessity be simple and efficient. The universal cargo carrier system idea, embodying the universal cargo carrier, was evolved in an endeavor to devise a physical or mechanical unit and method of employing same in such a manner as to attract all shipments, not attracted by the all-rail or carload movement, and to profitably expedite their

handling by efficiently and economically providing a complete service, in all that the name implies, in the various traffic fields.

The articulated universal cargo carrier is constructed with standard automotive rubber tired wheels for highway service and also with flanged metal railway wheels for rail operation.

The construction and operation of the universal cargo carrier does not involve any new or radical design. It does involve a new combination of designs, devices and forms of construction which have been proven in their respective fields. The structure of the highway end of the carrier is standard with the regular highway design. The rail end construction follows designs long standard in some European rail equipment and utilizing present approved features such as roller bearings, standard air brakes, rubber cushioning, improved spring designs, etc. The automatic elevating, lowering and coupling devices are similar to those used in highway tractor and semi-trailer service with such changes as were necessary for their adaptation.

The frame, undergear, couplers, etc., are practically the same or standard for all carriers. The super-structures or bodies, however, may be designed to suit the various classes or types of cargo handled. Stock, hopper, refrigerator, gondola, box or horse (side, end, or removable hatch) bodies may be constructed in such a manner as to be interchanged as desired, thus making it possible for one carrier chassis to serve more than one body, switching bodies as dictated by the demands for the various types, as occasioned by shifting traffic.

Cargo slings (webbed bands, crosswise and lengthwise hooked into the walls of the carrier body, as many on both horizontal and vertical planes as may be desired) make it possible to very largely do away with the necessity for packing or crating, and will prevent shifting of cargo.

The bodies, by means of quickly operated anchors and clamps, may be hastily fastened to or removed from a carrier chassis; the construction of special types of bodies when desired is a comparatively simple matter. Removable bodies in effect could be classed containers. The utility of the container can be extended universally with the articulated universal cargo carrier, and would not be confined to territories adjacent to crane service or other handling facilities, but can be hauled in rail trains to the way station door, farm, mill, etc., irrespective of weather conditions and without impeding rail traffic by delays for mounting or dismounting, so called, easy transferable types.

The use of the light-weight, high-strength metal alloys and low cost steels having good welding characteristics makes it possible to build carriers of light tare weight, thus increasing the pay load capacity.

Under practically all the present State laws, it is possible to design the carrier for an 8-ton pay load. In some of the States a 10-ton pay load or greater is permissible with the indications that the load capacity will be increased for suitable equipment.

The carriers may be efficiently operated on any highway or street suitable for standard tractor and semi-trailer or tractor and trailer operation at speeds of 45 miles per hour and on the railway in trains of 50 carriers, or less, at 60 or more miles per hour.

The articulated universal cargo carrier system is a secondary, or auxiliary rail service to be operated independently, and is not designed to be connected in a train with standard present day equipment, with the exception of the motive power unit or locomotive. The power unit may be of any type desired, provided it has sufficient horsepower, speed, etc., to meet traffic de-

mands. The power unit, however, is not necessarily confined to this system but by special adaptor couplers, it can pull either standard equipment or the articulated universal cargo carrier train. The articulated universal cargo carrier system operating in a train of say 50 carriers and with the full utility of a highway vehicle, moves greater unit tonnage at higher speeds than possible with all-highway service, and with flexibility and a minimum of tare weight *not* possible in standard rail equipment.

The articulated universal cargo carrier system not only provides speed, utility, flexibility and low cost per ton-mile of trunk line transport, but reduces terminal congestion, classification, switching etc., which is, of course, an ultimate reduction in cost.

The articulated universal cargo carrier system assists in reducing highway maintenance, thus releasing funds for improving secondary and farm-to-market roads. The operating personnel in the highway part of the service will be improved in character and efficiency under uniform regulations, requirements, etc., with the possibility of attaining a position comparable with railway labor. As the highway transport is confined to local pick-up and delivery, the safety of the trunk highways will be greatly enhanced.

The method of operation might be illustrated as follows : A manufacturer or wholesaler located within a 25-mile radius of downtown Chicago calls a railway company advising of a shipment he wishes to send to a small town 10 miles inland from Fort Dodge, Iowa. He describes the shipment. The hour is 11 a. m. and the shipment will be ready for loading at 2 p. m. From the rail highway station nearest the plant a tractor hauls the carrier over street and highway to the plant. The carrier is spotted or placed for loading, if a full carrier load, the uncoupling lever pulled, the tractor easing out from under the coupler to go elsewhere on its regular tour of duty. This tractor or another one as directed by the transport office, arrives back to the plant at 4 p. m., the time set for completion of loading. The tractor backs under the carrier, automatically elevating and coupling, then proceeding to the rail highway station where the carriers are spotted or placed with the wheels in line with the rails of a siding or track section which has its rail treads level with the yard, highway, or street surface, the tractor being headed in a direction opposite to the general direction of travel of the carrier rail train. Carriers delivered to rail highway terminals or stations or intermediate terminals or stations, are all handled in this manner. When the rail power unit backs into this string of uncoupled carriers they are automatically elevated and coupled as shown in sketch (fig. 30).

The carrier rail train leaves at 6 p. m., and the next morning the carrier in question is, by reversing the operation, set out on suitable rail highway station siding at Fort Dodge, the train, picking up other carriers, waiting for it, and proceeding on its way. One of the tractors at Fort Dodge will without delay back under the opposite end of the carrier and deliver to the shop, store, farm, etc., of the consignee.

The consignor, who has a shipment of furniture that is less-than-carrier-load, telephones the railway, or transport agency. The tractor with cargo carrier attached calls at the consignor's shipping department and without uncoupling, loads the furniture, which is not crated, places cargo slings (webbed bands) across carrier body to hold furniture in place and to prevent other freight making contact due to shifting, etc. The tractor-carrier operator makes the billing and receives any prepaid revenue, then moves to other designated

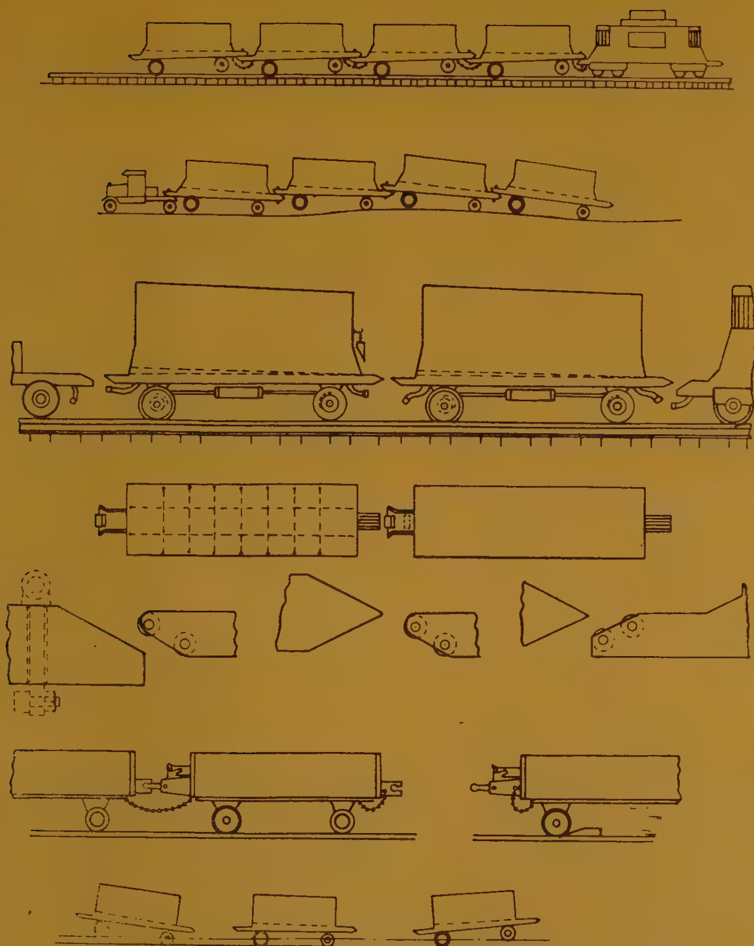


Fig. 30. — Rail-highway trailer.

stops for additional miscellaneous freight collection. After completing collection of miscellaneous less-than-carload freight at Fort Dodge from numerous consignors, the carrier is placed on the railway tracks for movement in regular scheduled high-speed carrier train to destination, where distribution is made over highway or street to numerous consignees.

If a farmer wishes to ship livestock to Chicago, the general method of operation is the same except that the delivery to the stock yards at the packing plant may be completed on the rail, thus operating on schedule, obtaining better markets, taking less shrinkage, etc. The carriers would be thoroughly cleaned for use in hauling farm implements, etc., in return movement to agricultural districts.

The articulated universal cargo carrier is an ultimate necessity for the economical transport of perishables. These car-

riers can be continuously refrigerated by proven means with less added tare weight than with any other type of refrigerator transport service. Continuous refrigeration from orchard, garden, distributor, etc., to retailer, or consumer, would extend a service impossible to attain with present equipment when time, speed, flexibility, economy and tonnage movement are considered. This continuous refrigeration transport service will greatly reduce marketing waste.

Illustrations, showing the transport of bulk and loose materials such as coal and gravel directly from mine or pit to consumer, etc., could be made, but the general system of operation is applicable to all commodities.

Any goods transport system, extending a complete service, must primarily be the ultimate in economy. The articulated universal cargo carrier system, herein described and operation illustrated, extends reduction in transport cost in many ways :

1. The average carload movement of less-than-carload goods transport, between most areas, is well within the capacity of the cargo carrier — therefore, the tare weight movement cost to the railroad using the cargo carrier system instead of standard equipment, would be greatly reduced.

2. The complete transport of a shipment by cargo carrier utilizes *one lading carrying vehicle* and a corresponding single investment.

3. Classifying and switching is automatically done off the rail while in regular off-rail service. Terminal trackage or storage requirements are reduced.

4. There will be reduction in transit time, handling and transfer, damage claims, etc.

5. The highway motor carrier operation by coordination with the railroad in extending this service, would experience lower operating costs, maintain improved supervision over personnel, would maintain his present business by extending a better service and would handle the additional railway tonnage. In other words, he would increase his tonnage but eliminate the trunk highway movement which is his greatest expense.

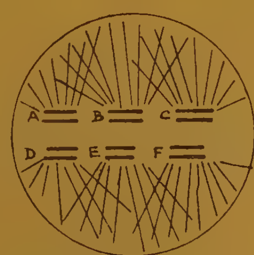
The development through this era of the new high-speed railway passenger train and the air service presents a new situation with regard to the intermediate collection and delivery of mail, parcel post and express.

These new high-speed services are indispensable to modern demands but a collection and delivery system must be coordinated to extend these services to outlying and remote territories. The articulated universal cargo carrier, properly coordinated by extending frequent and high-speed local and intermediate service and in conjunction with the star and rural mail routes would complete the distributive system of all transport. This service would operate with the goods transport in universal service and would not be duplicate.

The simplicity, flexibility, and serviceability, of the articulated universal cargo carrier and its adaptability to efficient and economic handling on the highway, on the railway as secondary equipment in carrier rail trains, on the railway hauled in suitably arranged standard or primary equipment flat cars, and on board ships, boats or barges, brings forcibly to the fore the question of who should own and operate such equipment. This is especially true when we give due consideration to what the future may hold in store.

The ownership and operation of the articulated universal cargo carrier system might be vested in the individual railroad, a universal agency or a private transport service operated under contract by the universal agencies or the railroads. The off-rail tractors, personnel and operation can be by direct

Small distributing center.
Single station "A,,.



Large distributing center.
Multiple stations "A,,, "B,,, "C,,, "D,, , etc.

Fig. 31. — A typical example of a potential rail-highway territory for one railroad.

ownership and control or by contract on tonnage basis.

Many, in view of the introduction of the diesel engine into commercial highway service, the traffic banding of highways (that is, assigning bands of main

highways, each class of traffic having a band of its own), elimination of grade crossings, etc., feel that the future development of highways and present plans for the building of national highways, which will be federally regulated, presents the possible public demand for economical long-haul transportation over these highways of trains of trailers operating as a complete system of trunk highway movement with large diesel tractors, setting out and picking up carriers at designated points for movement to adjacent feeder territories by small tractors for collection and distribution of goods. The articulated universal cargo carrier system is so designed to be operated in trains on the highway when the demand is presented. The mechanical feasibility of operating these trains is in the articulation.

Most of the traffic authorities, business men and engineers consulted, however, seemed to feel that the public welfare and the interest of all concerned, when consideration is given to all phases of our national and individual life, would be best served by a general co-ordination of rail and highway service, operating the articulated universal cargo carrier on the highway for collection and delivery service and on the railways for the long haul.

The balance of trade between production and consumption depends greatly on distribution. Distribution is primarily transportation. The establishment of a complete and economical transport service, extending lower rates to commerce, would promote the development of new industry near the source of raw materials and natural resources, aiding in the program of decentralization of over-populated metropolitan industrial areas, would extend trade territories, would assist in conservation and reclamation by providing markets for territories now economically inaccessible; and the cargo carrier construction would present, to established industry, work for machinery and hands now idle, to be extended through an indefinite period of rehabilitation of all transportation equipment.

The articulated universal cargo carrier system, employing the articulated universal cargo carrier, is based on proven theory and practice of transport, extending a service in keeping with the demands of the era, i. e., complete, high-speed, light-weight, flexible service, with the possibility of utmost economy.

[656. 211.5 (.493)]

Ticket printing machines in use at the booking office at Brussels (Nord) Station,

By A. DEPREZ,

Head of the Commercial Department, Belgian National Railways Company.

The issue of railway passenger tickets is attended with the same difficulties and is done under the same conditions on nearly every railway.

The solution — still so common — of keeping stocks of printed tickets ready for sale, may have met the needs of small railway systems with simple rates, but became less and less satisfactory as the number of stations grew, and the rates were more diversified.

The assortment of « ready-made » tickets, for these two reasons, had to become very large and involved a great increase in the stocks held, and at the same time the manuscript ticket had to be used to a growing extent.

The movement of all these « bearer bonds », as tickets printed beforehand are, from the printing works to the ticket racks in the booking offices issuing them to the public, means a whole series of responsibilities, complicated records and frequent checks, too well known to be dwelt on in this article.

Then too the manuscript ticket lends itself to fraud and mistakes, and thereby necessitates laborious checking after sale.

The space taken up is not the least drawback of the system, this being felt most in large stations where room is particularly valuable. The booking offices inevitably occupy a large area. Each window has to have a large assortment of tickets. The value of this assortment is high, and it is a real one, as each ticket issued from the racks must be represented in the till by its value in money. The ticket racks can only be transferred from one booking clerk to another after a complete check, which takes too long for a transfer to be made daily. A set of ticket racks, therefore, can only be used by one issuing clerk. When tickets are being issued continuously there must be as many sets of ticket racks as booking clerks in service per twenty-four hour period.

Another drawback not to be underrated is that the ticket offices are dark and unattractive when they contain many large ticket racks. An unfavourable feel-

ing is thereby raised in the passenger at his first contact with the railway : a psychological mistake which a wise tradesman should carefully avoid.

* * *

The desire to substitute a more rational system for the ready-printed ticket is an old one, and the method selected consisted of printing the ticket at the time of issue.

A machine which printed the tickets at the booking office was in operation, in 1896, at Renaix station, on the Belgian railways; no reliable control mechanism was fitted and the experiment was discontinued owing to fraud being possible.

This cause of failure no longer exists; the present machines provide an absolutely reliable check.

Without taking up too much space, besides being readily handled, the machines have, furthermore, such a wide range of production that they entirely solve the problem of printing tickets at the moment of issue. To get the maximum out of the machines, the ticket itself and the way it is used should be improved.

It will perhaps be interesting to show how the Belgian National Railways Company has succeeded in producing, with a single machine of normal dimensions, tickets of all classes for all stations on the Belgian railway system, without resorting to the manuscript ticket.

* * *

The machine used is the 2 000-plate A. E. G.

A detailed description of this machine and of its working is outside the scope of this article. Such a description can, however, be found in the following papers : « *Le Génie Civil* », January 1930, and *Revue Générale des Chemins de fer*, April and June 1932. Nonetheless a brief description may prove interesting (fig. 1*a*).

In the fixed horizontal box B, the plates are arranged upright in 8 longitudinal rows. The order of classification is shown on a prism P which is used to locate them. This prism has 8 faces, each of which corresponds to one row of plates. It can be moved backwards and forwards on horizontal guides, the printing carriage C moving with it.

When so moved, the rack makes it revolve so that the face seen by the operator corresponds to the row of plates under the carriage. This latter can slide on guides parallel to the prism. The two movements, « backwards—forwards » and « longitudinal », which can take place simultaneously, enable the carriage to be brought into the printing position over any plate. The index carried by the latter marks this plate on the prism.

When printing, the clerk inserts an Edmonson type card in the slot provided for this purpose in the carriage (fig 1*b*), and switches on the electric drive of the printing machine (fig. 1*c*).

In addition to being printed with the text on the plate, each ticket is dated, numbered and marked with the machine index letter. The ticket is ejected automatically.

The carriage prints, at the same time, the railway ticket, an accountancy slip and a check slip. These bands are rolled up in separate boxes. Should the check band break, the machine stops.

By means of the totaliser fitted to the

Fig. 1*a*.

Fig. 1*b*.

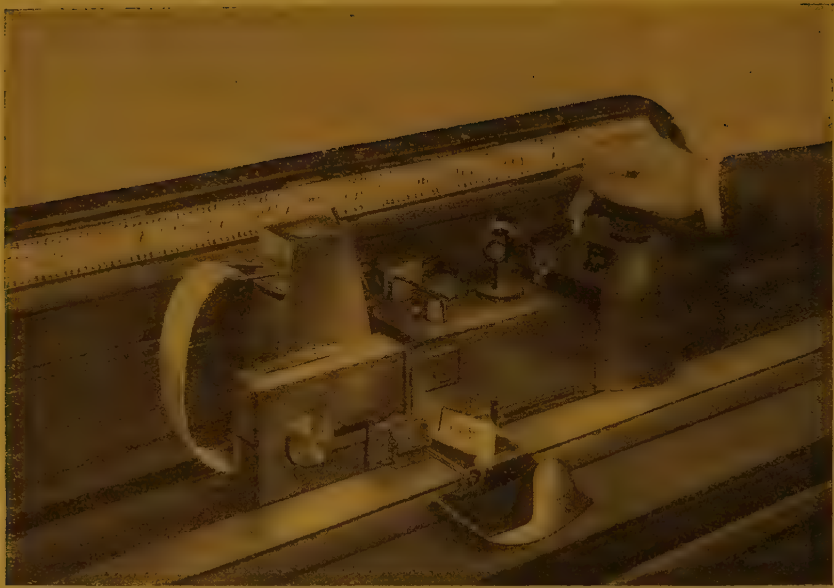


Fig. 1c.

machine, the total amount sold can be ascertained at any time.

Counters fitted in the prisms show the number of tickets printed off each plate, a figure required for getting out the statistics quickly.

* * *

The ticket issuing problem in Belgium (home services) is the following :

1. There are three classes of passengers;

2. Reductions of 25, 50 and 75 % on the usual rates are given under certain conditions.

25 % to 30 % percent of the total number of passengers carried are granted these reductions.

For each destination, there are therefore 15 classes of single and as many return tickets; in addition there are 3 classes of week-end tickets, or a total of 33.

As there are about 1 400 stations in Belgium (1 300 on the Belgian National Railways, and 100 on the other Companies' lines) one station may have to issue some 46 200 different types of tickets (1 400 × 33). Return tickets cost double the single. Week-end tickets, which are also return tickets, are issued at 25 % reduction on the normal rate.

* * *

The object in view was to print at the time of issue, with one machine of reasonable size, all tickets no matter their class and destination, so as to do away with the manuscript tickets.

Three methods of reducing the num-

ber of plates, and thereby the dimensions of the machine, were resorted to :

I.

The plate for a destination carries the full scale of rates for the single-journey :

with a reduction of 75 %;
» » » » 50 %;
» » » » 35 %;
» » » » 25 %;
and at full rate.

When at full rate, the ticket is issued as ejected by the carriage (fig. 2). When

Fig. 2.

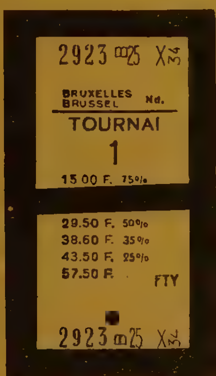


Fig. 3.

issued at a reduced rate, the part of the ticket under the reduced rate in question (fig. 3) is automatically clipped off by a shear with 4 slots, each corresponding to a reduced rate (fig. 4). The ticket is merely introduced into the proper slot, and a slight pressure exerted which turns over the apparatus (fig. 5). The detached part falls into the holder of the shear. As soon as the pressure ceases, the shear returns to its normal position (fig. 6).

Fig. 4.

Fig. 5.

Fig. 6.

At the end of the day the total value of the fragments is deducted from the receipts recorded on the accountancy band which has registered and totalised the amount at full rates.

II.

A number of destinations equidistant from the departure station are printed on the same plate, which prints them on the tickets.

The ticket so printed with a number of destinations is delivered to a passenger going to a particular one. There is ample room on the Edmonson type card for 4 destinations, but the number printed is limited to 3, and the remaining space is ruled for a manuscript entry of another station at the same distance (fig. 7). The reasons for this are :

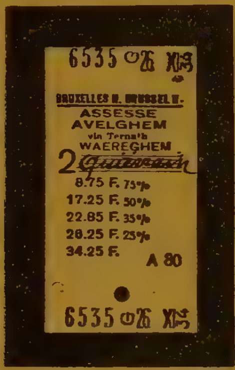


Fig. 7.

a) The equidistances generally increase as the stations are farther away, but the number of less used stations increases at the same time. A judicious selection based on the statistics of tickets sold has eliminated from the plates the destinations which, when needed, can be written in by hand. The number of plates is very considerably reduced in this way.

It is noticed that the equidistances, after increasing regularly with the distance away, diminish beyond a certain radius varying with the layout of the railway system, and the location of the issuing station (fig. 8). The usefulness of the multiple-destination ticket will not be reduced if, for long distances zone rates are substituted for kilometric rates. The introduction of zones, even on a small scale, would increase the field of application of the multiple-destination ticket with a blank space as the chart (fig. 9) shows (distances of 107 to 111 km.). Long journeys being the exception, this rate-making method causes no difficulties. The price alterations are relatively slight if the zones are limited.

Fig. 9.

Note : ● Geographical position. — ○ Rating distance (detours made by the railway included).

b) To meet road motor competition, the Belgian National Railways Company has introduced many fast light passenger trains for local traffic, with intermediate stops between the stations. Each time a service of this kind is started, new stopping places have to be provided for. The booking clerk enters the new destination in the blank space on a multiple-destination ticket for a corresponding distance. Consequently, existing plates need not be altered nor new tickets printed.

Fig. 10*a*.

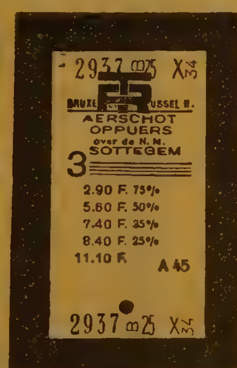
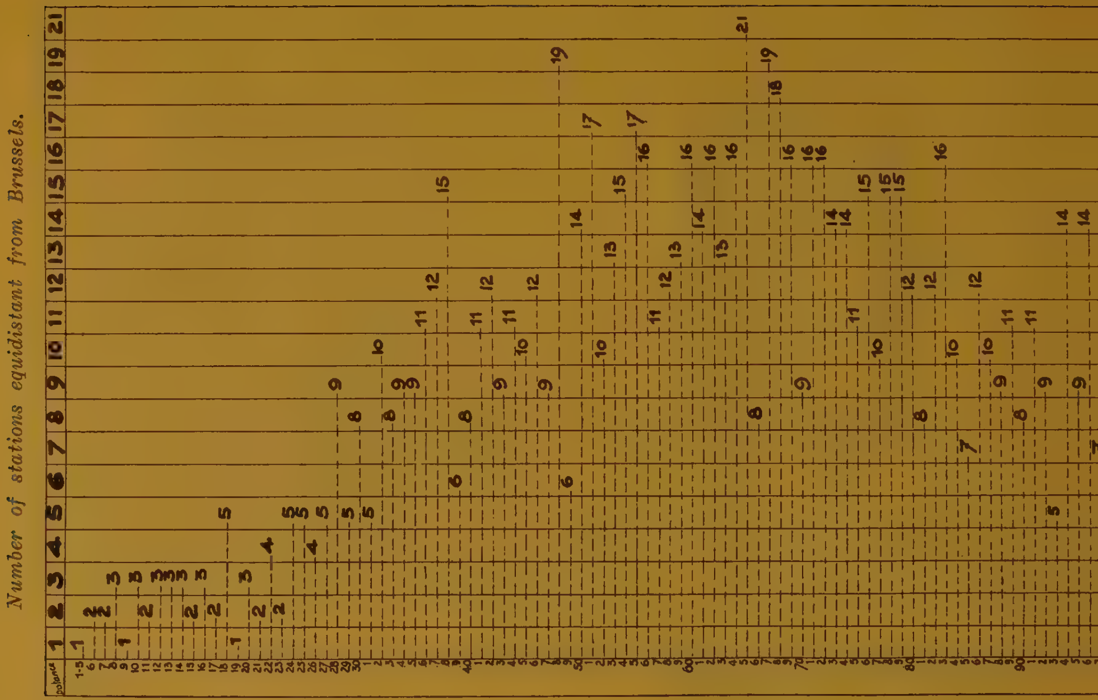


Fig. 10*b*.



III.

For a return journey, the booking clerk can deliver two tickets : one for the outward and one for the return journey, for which the single-journey

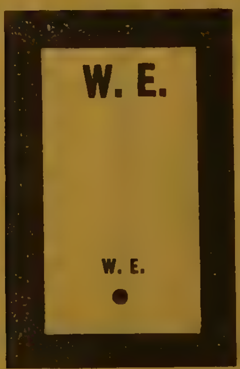


Fig. 11*a*.

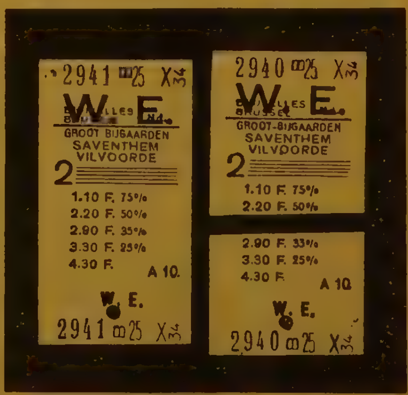


Fig. 11*b*.

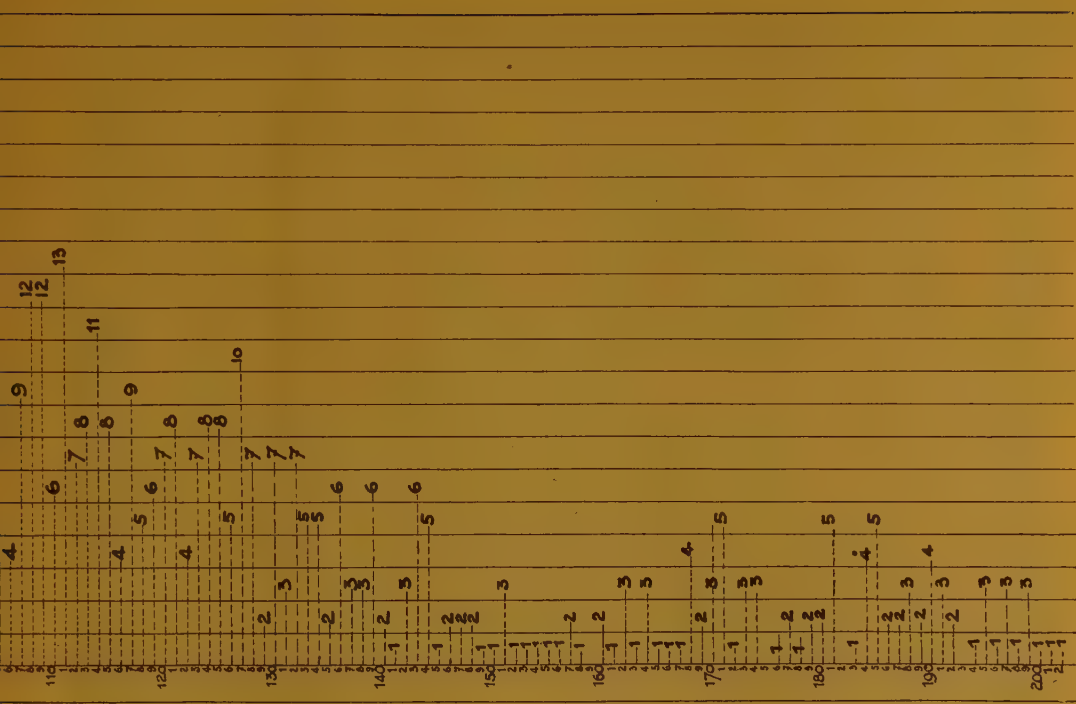


Fig. 8.

plates are used. In this case, he uses for the return ticket a card on which is already printed in heavy type the interlaced letters R. T. (Retour-Terug = Return) (figs. 10*a* and 10*b*). In the same way, for the week-end tickets, the cards are marked with the letters W. E. (Week-End) (figs. 11*a* and 11*b*).

* * *

These three methods — scale of prices, multiple destination with blank space, double tickets — used together and their possibilities made full use of — would reduce to less than one thousand the number of plates required by a Belgian station for printing all classes of tickets for all destinations. However, if two tickets were issued constantly for the out and home journeys, and if too many manuscript tickets were to be used, the issuing work would be somewhat slowed down. The same effect would be produced if tickets with parted sections had to be resorted to in too many cases and the time taken up by the deduction returns would be increased. In stations with large ticket sales, these methods should therefore only be moderately used.

For this purpose, the machine is provided with plates printing ordinary tickets (figs. 12*a* and 12*b*) for the more demanded destinations and classes. The use of the 2 000-plate machine makes this possible to the desired extent.

The preliminary study of the statistics of tickets sold determines, of course, the

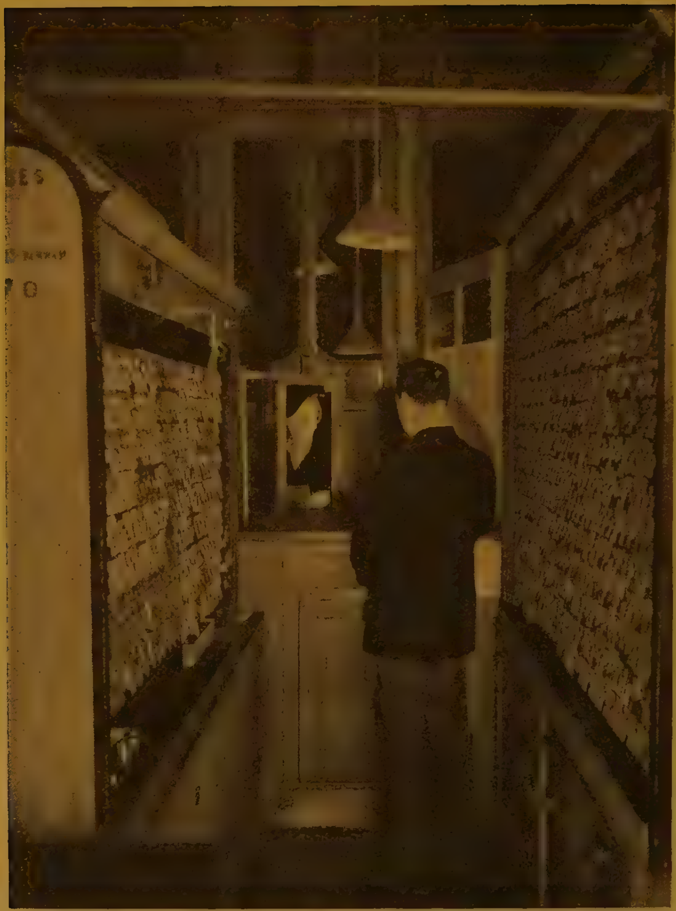


Fig. 13*a*.

best equipment of plates for rapid ticket issuing and for shortening the check of the reductions.

* * *

The machines used at Brussels (Nord), equipped on these principles, use 1 800 plates only out of the 2 000 available.

Whilst tickets of all classes for all Belgian destinations can be printed :

1. A single ticket is issued in 97 % of the cases for return and week-end journeys;

2. The number of tickets clipped off is reduced to 8 per thousand.

3. The number of manuscript tickets is only 10 per thousand. The machines can be pooled between all booking clerks; they all have the same plates and the same classification thereof.

* * *

Fig. 13*b*.

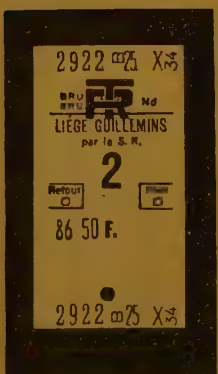


Fig. 12*a*.

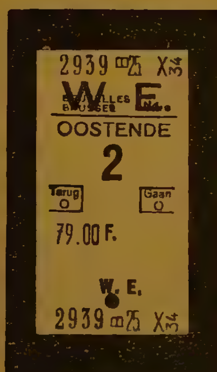


Fig. 12*b*.

For the normal issue of tickets in home service, Brussels (Nord) station uses 18 sets of card racks, each with some 1 100 classes of tickets. There were, however, only 11 ticket windows. The lack of room for increasing them made it necessary to use an arrangement which, although essential to meet the needs when issuing tickets, was particularly inconvenient; seven windows were provided with a double series of racks, so that two sets of clerks could work in turn (fig. 13*a* and 13*b*).

Seven machines were sufficient to replace this cumbersome installation. Each machine only requires a floor space of 2.04 m. × 0.925 m. (6 ft. 8 5/16 in. × 3 ft. 7/16 in.) and is 1.09 m. (3 ft. 7 in.) high (fig. 14).

Fig. 14.

Fig. 15.

Fig. 16.

The ticket office being completely cleared, now has an attractive appearance which the public appreciates; it is also more confortable for the staff (figs 15 and 16). The booking clerck works under better conditions, both hygienically and mentally; he is no longer responsible for a stock of tickets of very considerable value (up to 1 million francs). At the end of the day, he knows exactly his position as regards cash, which was practically impossible with the ticket rack system.

[621.132 3 (.44)]

Increasing the efficiency of express locomotives, Eastern Railways of France.

(The Railway Gazette).

In keeping with the general policy of the French railways, the Chemins de fer de l'Est, or Eastern Railways of France, have endeavoured to increase the schedule speed of their fast trains, which are hauled by compound locomotives of the 4-6-0, 4-6-2, and 4-8-2 wheel arrangements. The desired end could be attained only by increasing the running speed on sections where the maximum permissible speed (generally 120 km. or 74.6 miles an hour) was not already reached. This required the development of increased power at speeds from 75 to 120 km. (46.6-74.6 miles) an hour, the locomotives of the types mentioned originally developing their maximum output at speeds in the neighbourhood of 75-80 km. (46.6-49.7 miles) an hour, beyond which the available power decreased progressively. The alternative of increasing speeds by reducing the number of coaches in trains was commercially impracticable, especially as the progressive replacement of wooden by all-metal coaches resulted in heavier trains.

Modifications introduced.

The only acceptable method of accelerating services, without the wholesale provision of new locomotives, was to modify the existing locomotives in such a way as to increase the power available at high speeds. The limitations of the locomotives in their original forms were found to be due partly to low efficiency of the boiler at high rates of steaming, and particularly to inadequate steam passages resulting in serious distribution losses when it was attempted to develop high power at high speeds. In order to remove these limitations, the company decided to effect modifications as follows :

1) Increased steam pressure.

2) Improved distribution to reduce the losses between the throttle and the high-pressure cylinders, and between the high and low-pressure cylinders.

3) Double-port piston valves (or poppet valves) on the low-pressure cylinders to increase the effective output.

4) Reduction of back-pressure and improvement of draught by fitting a large high-efficiency blast pipe.

5) Increased superheat.

6) Application of a feed-water heater to reduce the consumption of water and coal.

These changes were introduced experimentally in several 4-6-0 and 4-8-2 locomotives with such satisfactory results that the transformation of all the locomotives of these types is now in progress. The modifications of several 4-6-2 locomotives are also in hand and the preliminary tests on this type are very encouraging.

Results obtained.

The accompanying table gives leading particulars of the three types of locomotives as modified (the corresponding data before modification being shown in brackets where a change has been effected). Supplementary notes relating to the modifications are given in the following paragraphs together with the results as at present ascertained.

4-6-0 type.

The converted locomotives are fitted with a feedwater heater taking steam

Leading dimensions of modified locomotives of the Eastern Railways of France.

(*N. B.* — Where alterations have been made, the original dimensions, etc., are shown in brackets).

Locomotives : Type and Serial Nos.	4-6-0 Nos. 3231-3280.		4-6-2 (*Pacific*) Nos. 31001-31040.		4-8-2 (*Mountain*) Nos. 241001-241041.	
Cylinders, diam., h.p.	370 mm. (405 mm.)	14 9/16 in. (15 15/16 in.)	420 mm.	16 17/32 in.	425 mm. (450 mm.)	16 3/4 in. (17 11/16 in.)
» » l.p.	590 mm.	23 1/4 in.	640 mm.	25 3/16 in.	660 mm.	26 in.
» stroke	680 mm.	26 3/4 in.	650 mm.	25 19/32 in.	720 mm.	28 3/8 in.
Piston valves, diam., h.p.	270 mm.	10 5/8 in.	270 mm.	10 5/8 in.	250 mm.	9 27/32 in.
» » l.p.	300 mm. double-port (350 mm. single-port)	11 13/16 in. double-port (13 3/4 in. single-port)	350 mm. double-port (flat slide valves)	13 3/4 in. double-port (flat slide valves)	300 mm. double-port (310 mm. single-port)	11 13/16 in. double-port (12 3/16 in. single-port)
Admission lap, h.p. and l.p.	27 mm.	1 1/16 in.	27 mm.	1 1/16 in.	36.5 mm. h.p., 37 mm., l.p.	1 7/16 in. H.P., 1 29/64 in l.p.
Exhaust lap, h.p.	— 6 mm. (zero)	— 15/64 in. (zero)	— 6 mm. (— 3 mm.)	— 15/64 in. (— 1/8 in.)	— 6 mm. (zero)	—15/64 in. (zero)
» l.p.	— 3 mm.	— 1/8 in.	— 5 mm.	— 3/16 in.	— 10 mm.	— 25/64 in.
Ratio of swept volume, l.p. cyl./h.p. cyl.	2.547 (2.138)	—	2.32	—	2.41 (2.16)	—
Regulating pressure of receiver valve	6 hpz.	87 lb. per sq. in.	6 hpz.	87 lb. per sq. in.	7 hpz. (6 hpz.)	102 (87) lb. per sq. in.
Coupled wheels, diam.	2 090 mm.	6 ft. 10 1/4 in.	1 950 mm.	6 ft. 4 3/4 in.	1 950 mm.	6 ft. 4 3/4 in.
Boiler working pressure	18 hpz. (16 hpz.)	261 (232) lb. per sq. in.	17 hpz. (16 hpz.)	247 (232) lb. per sq. in.	20 hpz. (17 hpz.)	290 (247) lb. per sq. in.
Grate area	3.14 sq. m.	33.79 sq. ft.	4.27 sq. m.	45.94 sq. ft.	4.43 sq. m.	47.67 sq. ft.
Type of superheater	DM3 (DM4)	—	DM3 (Schmidt)	—	DM3 (DM4)	—
» blast pipe	Large section trefoil (Nord)	—	Large section trefoil (Nord-trefoil)	—	Large section trefoil (ordinary trefoil)	—
Chimney, diam. at top	610 mm. (425 mm.)	24 in. (16 3/4 in.)	620 mm. (440 mm.)	24 3/8 in. (17 5/16 in.)	600 mm. (460 mm.)	23 5/8 in. (18 1/8 in.)
» diam. at throat	500 mm. (380 mm.)	19 11/16 in. (14 15/16 in.)	500 mm. (325 mm.)	19 11/16 in. (12 13/16 in.)	500 mm. (380 mm.)	19 11/16 in. (14 15/16 in.)

from the foot of the blast pipe. The first locomotive to be modified was No. 3249, the high-pressure valve chests of which were fitted with a communicating pipe to equalise the steam flow and utilise the two admission pipes simultaneously for cut-offs below 50 %. As a result of the modifications, locomotive No. 3249 develops its maximum power at 110 km. (68.4 miles) an hour, compared with

Figs. 1 and 2. — Front end views of (left) modified 4-6-0 locomotive No. 3249, and (right) one of the converted 4-8-2 type, Eastern Railways of France.

75 km. (46.6 miles) an hour in the original machines. The outputs developed by the high and low-pressure cylinders are approximately equal, thus equalising the driving torque. For equal consumption of water per mile, the increase in power resulting from the modifications is about 50 %. The maximum sustained drawbar horsepower, without exceeding a rate of combustion of 550 kgr. per m² (112.6 lb. per sq. ft.) of grate area per hour, is 1 340 metric H.P. at 85 km.p.h. (1 323 H.P. at 52.8 m.p.h.) for locomotive No. 3249, compared with 990 metric H.P. at 65 km.p.h. (977 H.P. at 40.4 m.p.h.) for a non-modified locomotive. On this basis, the gross gain is only 35 %, but if the maximum outputs be compared at equal speeds the difference in favour of the modified locomotive increases as the speed rises.

The consumption tests on the modified locomotive No. 3249 show that there is about 30 % saving in water consumption, and 40 % saving of coal per drawbar H.P.-hr. Moreover, these savings per-H.P.-hr. remain practically constant for a given speed whatever the power developed, which is not so in the case of the unmodified locomotives.

4-6-2 (Pacific).

The low-pressure cylinders of these locomotives were originally fitted with flat slide valves and will be replaced by cylinders with double-port piston valves or with Dabeg poppet valves, according to the results of trials now in progress.

Figs. 3 and 4. — General side view of (above) Est 4-6-0 locomotive No. 3249 and (below) 4-8-2 No. 241-038, both as now modified.

Only one modified locomotive of this class has yet commenced its trials, but it is already apparent that the reconstruction has resulted in considerable improvement in steaming, both in capacity and efficiency.

4-8-2 (Mountain).

The converted locomotives have been fitted with exhaust steam feed-water heaters. The first locomotive to be modified, No. 241.038, is provided with separate-chamber superheater header, large admission pipes and an equalising pipe between the high-pressure steam chests. Trials with this machine show that the maximum power is attained at a speed of about 100 km. (62.1 miles) an hour, compared with 80 km. (49.7 miles) an hour in unmodified locomotives of the same series. The drawbar horsepower has been increased by about 40 % at given cut-off and speed and an indicated output of about 3 700 metric H.P. (3 652 I.H.P.) is attainable at 100 km. (62.1 miles) an hour, the output of the two groups of cylinders being also appreciably equalised. On an average, the modifications have reduced the water and fuel consumption of this locomotive by about 15 % for the same drawbar H.P.

Conclusions.

The modifications effected in the 4-6-0 and 4-8-2 locomotives have resulted in higher drawbar horse-power at high speeds, the increase amounting to about 50 % in the former locomotives and 40 % in the latter locomotives. At the same time, the consumptions of water and coal have been materially reduced.

The alterations, which have involved a minimum of expense, consist mainly in the application of double-port piston valves to the low-pressure cylinders, and in an improvement of steam distribution and exhaust effected while utilising existing pipes, cylinders and motion work.

[621. 43 (.492)]

The Dutch diesel train failures.

(*Diesel Railway Traction*, supplement to *The Railay Gazette.*)

It is widely known that the 35 Maybach-engined diesel-electric trains of the Netherlands Railways were withdrawn from service in August 1934, following a series of engine breakdowns.

At the end of that month, Mr. Hupkes, the Superintendent of Rolling Stock of the Netherlands Railways, issued a statement to the Dutch press which read as follows :

In August some inexplicable failures began to occur with the diesel trains, failures which have not hitherto been experienced with engines of the type in question. An inquiry was instituted and the conclusion reached was that the diesel engines were working under unfavourable conditions on our system. The principal objection was that they ran much of their time at reduced speeds, which caused them to be overloaded. Certain defects were also experienced with the fuel and lubricating oil supply systems. The breakdowns of the trains were in the main attribuable to these causes.

Since all the trains were operating under the same conditions it was presumed that they were all liable to the same defects and it was decided, therefore, to submit them all to a thorough inspection. This decision was made on August 23, after the trains had been in service a maximum of ten weeks.

Engine maker's view.

According to a statement made by Maybach Motorenbau, whose engines were installed, the trains were constructed to meet the definite ideas of the Netherlands Railways. For instance, the engines and power equipment generally were mounted on the underframe in the centre vehicle, and not directly on the bogies, as had been done in Germany and France. With this arrangement (see accompanying illustration), it was not found possible to arrange the fuel tanks in the roof of the car and thus allow of a gravity feed to the engine. The tanks were therefore located beneath the underframe, and air from the brake system was used to feed the fuel from the tanks to the pumps. The tanks themselves were made of aluminium which was so thin as to limit severely the air pressure which could be used. These facts, if is said, were pointed out by Maybach but were not taken into account by the railway company.

A more serious allegation is that the Maybach engineers recommended that

Fig. 1. — Four of the 820-B.H.P. Maybach-engined diesel-electric trains at Utrecht.

the electric transmission characteristics should be arranged to prevent any load being taken up by the diesel engine until a rotational speed of about 1 000 r.p.m. was reached. The equipment actually installed provided for load being taken up at 800 r.p.m., at which speed the generator was capable of dealing with 200 B.H.P. The railway company's engineers are understood to have stated that this would occur only for a moment or two at starting, but it appears that in service these low rotational speeds were used a good deal and the motors were thus overloaded more or less continuously. In addition, the fuel supply was irregular, due to the low air pressure and lack of control. On some occasions enough fuel did not reach the combustion chamber and certain cylinders did not fire. This slowed down the engine, and then the governor caused the injection pumps to increase the fuel charge, overloading the remaining cylinders so badly that shock absorber springs were broken, big-end bearing failures occurred, several pistons were broken, one or two cylinder walls cracked, and a few crankshafts fractured. The position was aggravated by certain defects in maintenance, such as failure to clean the fuel and lubricating oil filters.

As a result of the breakdowns, the Maybach firm now claims that its advice as to the control of the electrical equipment is being taken, and that the fuel supply system is also being changed, and also emphasised that such troubles have arisen only through the special circumstances in Holland, and have not been met with in Germany, France, or Belgium.

Electrical equipment manufacturers.

On the other hand, Brown-Boveri, the firm responsible for much of the electrical equipment, in a statement, expresses strong disagreement with Maybach,

and says that the engines were not overloaded on account of wrong transmission characteristics, and that at 690 r.p.m., the load actually attained in service was only 95 B.H.P. as a peak, whereas the engine builders had stated that 226 B.H.P. could be attained as a maximum at this speed. Certain faults, however, developed in the operation of the electrical equipment. There were cases of defective working of the electro-magnetic contactors, due to the great voltage variation, and slight defects also developed in the electro-magnetic speed governor. Further, breakage of the brush-gear cover occurred, and the aluminium fan which supplied ventilation to the traction motors was also broken. Brown-Boveri says that defective material accounted for this to some extent, but the failures were partly due to excessive mechanical stresses at road speeds of 62 m.p.h. One or two breakages occurred in the traction motor pinions, which, at the express wish of the Netherlands Railways, had been fabricated by Krupp.

Werkspoor view.

Werkspoor N.V., who built 20 of the Maybach engines under licence and also 25 mechanical portions of the trains, has, through its London representative, confirmed generally the statement of Maybach, but adds that there was a certain amount of overheating of the big ends which was rectified when the lubrication system was changed. According to this Dutch firm, the transmission equipment was designed so that at an engine speed of 800 r.p.m. the load would be 150 B.H.P. At this speed the combustion pressure is not sufficiently counteracted by the inertia forces, and a rapid increase in the combustion pressure produces sudden mechanical shocks. Frequent working under such conditions led to many defects developing in pins and bearings, but Werkspoor considers that a modification whereby the lowest rate of power revolutions would be 1 000 per minute would remedy this.

The case of the Dutch trains is somewhat different from that of the Flying Hamburger, in which the Gebus system in actual fact is used only for starting; the diesel engine runs at the rated speed of 1 400 r.p.m. nearly all the time. In Holland, a speed of 90 m.p.h. was proposed as a maximum, but as neither the track nor the signalling was suitable for such speeds, it was decided to limit the maximum to 62 m.p.h. until such time as operating conditions were suitable. This reduced the rotational speed of the diesel engines and increased the troubles. Regarding the fuel supply system, Werkspoor believes that the installation of a small feed tank in the roof would put things right, and this firm also suggests that the right kind of oil was not used for the cylinder lubrication and that deposits were formed which led to the damaging of piston crowns and rings.

Conclusions.

Although it seems to be generally agreed that the characteristics of the diesel engine and electrical equipment were not properly co-ordinated, we believe that a certain amount of the trouble was due to unsatisfactory design and unsuitable material of the pistons, which permitted undue expansion, with deleterious effect on the cylinder walls, big-ends, and on the pistons themselves. It is said that a material with a lower coefficient of expansion has since been substituted. The heating of the big-end bearings, stated to have been experienced at an early period, is an unusual fault with roller bearings; some trouble has been occasioned with these bearings on other Maybach engines, and the result has been pitting and scoring of the rollers and races in a manner which

suggested other faults than overheating.

The main source of trouble, however, appears to have been that the modified Gebus transmission had a limiting zone which permitted the engine to develop too high an output at a speed of about 800 r.p.m., and it is difficult to see (if the Maybach statement is true) why the design of the transmission was allowed to be such that load could be taken up 200 r.p.m. below the recommended figure. Of course, there may have been an undiscovered error in the design calculations. Incidentally, the firing order of one cylinder bank was changed to 124653 from the 153624 of the Flying Hamburger original engines.

With the diesel engine in its present state, the Dutch experience is a decided pointer to the necessity of great are

Fig. 2. — Layout of engine room of Maybach-engined Dutch train; view taken from hatchway.

being taken in getting the correct relationship between the engine and generator characteristics, especially when it is intended to use a control system which permits the engine speed to be infinitely variable within rather wide limits. If for any reason, absolutely constant-speed engine operation is not desired, it would seem preferable to arrange for two, or perhaps three, definite speeds (well away from the criticals) at which the engine may run continuously, in order to give maximum fuel economy when the full-speed full-load rate is not required.

We understand that the transmission is now being modified to prevent load being taken below 1 000 r.p.m. (an arrangement which is used on the streamlined trains of the Ch. de fer du Nord, in France), but with the same type of modified Gebus control it is difficult to see how this will completely rectify the troubles, as the vehicles were designed for a maximum speed of about 90 m.p.h. The rated engine speed and load will naturally be used at this velocity, and apparently it is intended to use this combination at the present maximum traffic figure of 62 m.p.h. But unless running up grade at this latter rate, the engine speed will be the rated 1 400 r.p.m. and the load will not be the rated 410 B.H.P. This will cause the engine speed to drop, for it is a characteristic of the Gebus system that the generator always requires maximum power at the maximum rotational speed. If the maximum output is not required, the driver must diminish the engine speed, and this sets up a new conbination of power characteristics.

It is quite understandable that all the *other* faults which developed in the Dutch diesel trains, taken together, would result in severe overloading, and would be able to produce unexpected criticals and upset the normal balance of the engine. Of course, a good deal

of trouble must have been caused through the haste with which the whole order was conceived and executed. Even the crying need of substantial reduction in operating expenditure should not have been attempted at the cost of a hurried design, and without trying one or two sets in normal service beforehand. Such a procedure has not been adopted by any other administration, for it is generally recognised that even when two or three high-power high-speed vehicles are set to work first, minor troubles arise which are easily rectified, but which would result in a good deal of disorganisation if a large number of units was involved. Nevertheless, the decision to put 40 triple-articulated trains into service at once must not be blamed on the mechanical department, but rather on those who presented that department with such a demand.

As far as we are aware, similar faults have not occurred in the five train sets which are fitted with eight-cylinder

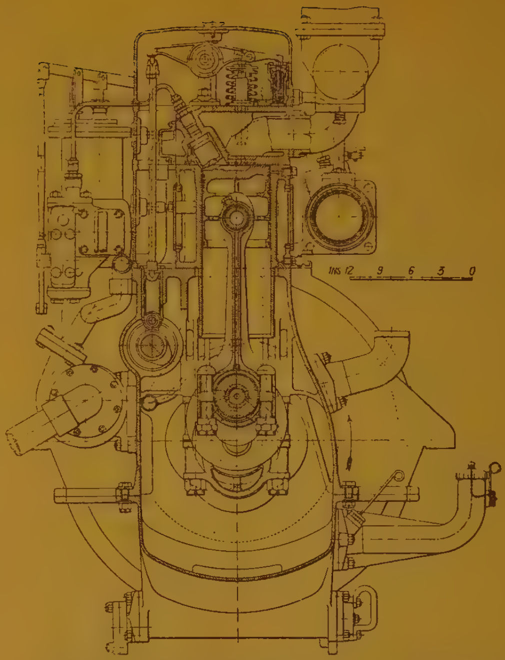


Fig. 3. — Cross-section of 400 B.H.P. Stork-Ganz engine.

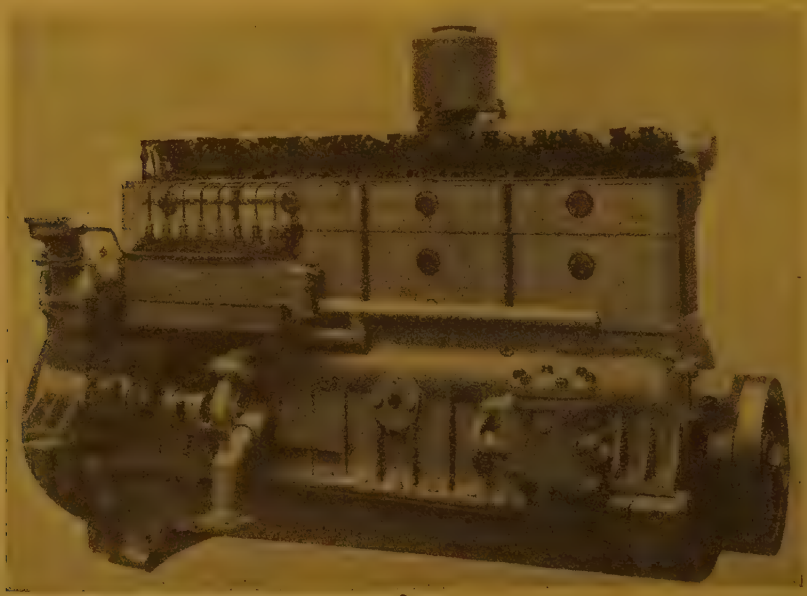


Fig. 4. — Fuel-pump side of 400-B.H.P. Stork-Ganz engine as used in five of the Netherlands Railways diesel-electric trains.

Stork-Ganz engines developing 400-B.H.P. at 1 450 r.p.m., and which have been in regular service on the Netherlands Railways since the beginning of November, 1934. The electric transmission in this case was manufactured on Westinghouse principles by Smit, of Slikkerveer, but constant engine-speed control has not been adopted, and six definite designed speeds (including idling) are claimed. The engine is provided with the normal Ganz-Jendrassik pre-combustion chamber, and has cylinders of 6.7-inch bore by 8.7-inch stroke. Advanced rating characteristics are a feature, for the design postulates a piston speed of 2 090 ft. per sec. and a m.e.p. of 89 lb. per sq. inch at top rated output, and the weight is equivalent to 16.0 lb. per B.H.P. Some of the main features can be picked out in the accompanying cross-section, but two atomisers are led into one antechamber in place of the single unit shown in the draving. The cylinder block and cylinder heads are of cast iron, and the crankcase, sump, and valve gear casings are of silumin.

The designed speeds of this engine are 960, 1 600, 1 200, 1 300, and 1 400 r.-p.m., with 800 r.p.m. for idling; the speed of 1 450 r.p.m. is regarded as an absolute maximum. We were present at the shop tests of one of these engines, and noted the following figures for the output of the attached generator :

Engine r.p.m.	Volts.	Amps.	Kw.
960	225	140	31.5
1 060	250	820	205
1 060	420	290	122
1 200	450	310	140
1 300	500	330	165
1 300	400	600	240
1 380	250	880	220
1 400	340	550	186
1 400	290	600	174
1 400	200	1 050	210
1 410	525	320	168

The greatest load in the above table is 240 kw., or 322 B.H.P., which, at 90 % generator efficiency, is equivalent to an engine B.H.P. of 358, almost equal to the continuous rating of 365 B.H.P. at 1 400 r.p.m. One of these engines was run on the test bed for 64 hours on end, with only two short stops, one because of a fault in the water-brake, and the other because of some foreign matter which found its way into the atomiser.

[656. 256 (.73) & 656. 258 (.73)]

Automatic interlocking on the Brooklyn-Manhattan Transit,

by A. A. ROBERTS,
Engineer of Signals, Brooklyn-Manhattan Transit, Brooklyn. N. Y.

(Railway Signaling.)

The seventh of a series of automatic control systems, applied to existing manually-operated interlocking plants on the subway and elevated lines of the Brooklyn-Manhattan Transit Corporation since 1922, was recently placed in service at the Navy Street junction between the Myrtle Avenue and Lexington Avenue double-track elevated lines carrying passenger traffic between Brooklyn Bridge terminal and outlying districts of the Borough of Brooklyn.

This junction point has been operated since about 1905, by a five-lever, electro-pneumatic interlocking consisting of two switches, three home signals and three dwarf signals. In 1932, when the Myrtle Avenue line was equipped with block signals, the original semaphore signals at Navy street were replaced with color-light type signals.

The new automatic control features for the Navy Street plant supplement the manual control, thus permitting either manual operation by a towerman or automatic operation as desired. Selection between manual and automatic control is made by means of lever No. 1 in the interlocking machine, which serves as a transfer lever, and is electrically and mechanically interlocked with all other levers.

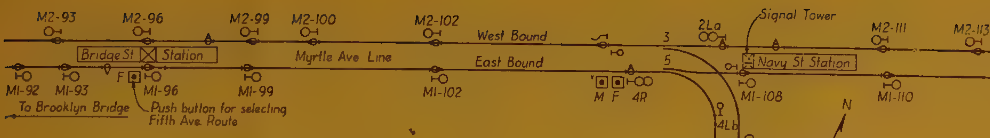
The track and signal arrangement at Navy Street junction is shown in the track diagram. A two-story tower at the west end of Navy Street station contains the interlocking machine on the second floor. The lower part of the tower contains the control relay and power supply equipment.

At Bridge Street, a double-length platform permits two trains to occupy the station at the same time on either track. This arrangement, which facilitates the transfer of passengers from one line to the other, introduced several complications, particularly in route-selection apparatus for eastbound trains.

Fig. 1. — Motorman selecting Fifth Avenue route by pushing button at Bridge Street station.

Method of route selection.

The automatic control system operates switches and home signals for trains to proceed through the interlocking in the same consecutive order in which they



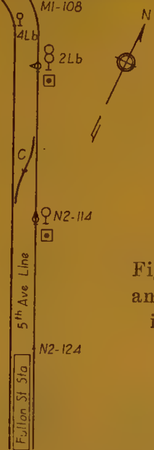


Fig. 2. — Track and signal plan of interlocking at Navy Street.

arrive at the locations where the route is selected. Westbound Myrtle Avenue and Fifth Avenue trains select their routes, over trailing point switch No. 3, immediately after the forward end of trains pass block signal M2-111 and N2-114 respectively; the first train to pass either of these points is the first to receive a proceed signal. The second train then automatically receives a proceed signal, unless a conflicting train movement has obtained right of way. Train movements against the normal direction of traffic, seldom made at this junction, are not provided for in the automatic control features.

Eastbound trains select the Myrtle Avenue or Fifth Avenue route, over switch No. 5, upon arriving at Bridge Street station, although the switch is not operated nor the home signal cleared for eastbound routes until trains proceed beyond signal location M1-102, located approximately midway between Bridge Street station and home signal 4R, governing the route.

Motormen on trains destined for the Fifth Avenue route, after stopping at the westerly section of the station, are required to operate a pushbutton, so located as to be easily reached from the motorman's cab window. Operation of this pushbutton is the only manual feature connected with the automatic control of the interlocking plant. Trains destined for the Myrtle Avenue route automatically select this route at the instant when the forward end of the trains enters upon a short track circuit immediately after passing signal location M1-96, located near the center of the platform. Electrical interconnections prevent the selection of more than one route by any particular train, or any change or cancellation of a route after selection has taken place. If a motorman's error results in the selection of the wrong route at Bridge Street, he may correct the error by stopping at home signal 4R and operating one of two auxiliary pushbuttons, provided at this location, for rectifying the route line-up.

The distance between the west end of Bridge Street station and home signal 4R, approximately 1 200 feet, is sufficient to allow three or four trains to occupy this section of track, each of which has made its route selection at Bridge Street station. It has been necessary, therefore, to make provisions for storing up the route-selection indications, for at least four trains, in the same consecutive order in which these indications are originated. The stored-up indications must then act to establish the corresponding eastbound route through the interlocking plant in the sequence determined by the relative positions of such trains. The leading

train, nearest home signal 4R, which governs eastbound routes through the plant, thus receives the correct route line-up, irrespective of route selections that may have been made by following trains.

In order to accomplish this purpose, engineers of the company's signal department developed a train-sequence route-selector which will be referred to, in the following description, as the « sequence unit ».

Description of train-sequence route-selector.

The apparatus constituting the « sequence unit » consists of twenty-three

Fig. 3. — The train-sequence route-selecting equipment employs telephone-type relays.

48-volt, d.c. telephone-type relays, purchased from the Automatic Electric Company, and assembled under group covers on a spring-supported frame in a dustproof metal cabinet, located on the second floor of the signal tower. Current for operating the relays is supplied directly from a dry-plate-type rectifier connected to the 25-cycle signal power supply source.

Four groups of relays in the unit serve as registers, which receive and store up, in consecutive order, a maximum of four route-selection indications corresponding to either Myrtle Avenue or Fifth Avenue line trains. One of two route relays in register No. 1, corresponding to the route destination for the leading train, nearest 4R signal, acts automatically to operate switch No. 5 and clear home signal 4R for the proper route. After the first train passes through the interlocking plant, the corresponding route indication in register No. 1 is cancelled, immediately followed by a successive transfer of route indications, that may have been stored in registers Nos. 2, 3, and 4, into registers Nos. 1, 2, and 3 respectively. The route indication corresponding to the second train then occupies register No. 1, which again establishes the correct route line-up. This registering and cancellation process continues in progressive order as long as the interlocking is under automatic control. The sequence unit continues to operate also, whenever the plant is being manually operated; in this case, the unit serves merely to control two route-indicating lamps, located in the spotlight track diagram above the interlocking machine.

Telephone-type relay equipment was chosen for the sequence unit because of greatly reduced initial cost and space requirements, as compared with results that could be obtained with larger and more expensive relay apparatus. The telephone type of relay equipment was considered satisfactory from a safety standpoint in this instance, since the protective features associated with the

automatic operation of switch and signal equipment are not in any manner involved in the operation of the sequence-unit control. Failure in the operation of this unit does not stop the operation of trains through the plant. In the event of such a failure, motormen of eastbound trains are required to stop at home signal 4R and select the proper route by means of the two pushbuttons previously mentioned.

The hand-operated crossover on the Fifth Avenue line, designated « C » on the track diagram, is used occasionally by work trains. Motormen on such trains, desiring to use the crossover, are required to operate pushbuttons, located at signal N2-114 and home signal 2Lb, in accordance with posted instructions. The purpose of these pushbuttons is to prevent trains using the crossover from interfering with the free movement of eastbound and westbound trains on the Myrtle Avenue line, while irregular train movements over the crossover are in progress.

Interlocking protective features.

Automatic and manual control of the interlocking equipment is fully protected by approach and route locking, track-circuit detector locking and S.S. control features. Each switch is locked by at least two track circuits. The approach locking becomes effective for any route as soon as the home signal clears, and is not released until trains have progressed to a point where two track circuits, locking the switch, are occupied.

Single-break control circuits with a common return are used for the major part of the equipment. S.S. switch-repeating relays, however, are supplied with current from an insulating transformer. Two switch-repeating relays are used for each switch; one checking the normal and the other the reversed position. These relays are controlled through contacts of circuit controllers connected to switch points and switch locking bars, as well as through contacts of corresponding switch levers in the interlocking machine when the plant is being manually operated by a towerman.

Signal equipment.

Color-light-type signal equipment, including signal and interlocking control apparatus, such as a-c., motor-operated relays and train-stop mechanisms, were obtained from the General Railway Signal Company. The block signals display green, yellow and red aspects, indicating « proceed, » « caution » and « stop » respectively. Home signals consist of two green, yellow and red light units with an additional yellow light, which, in conjunction with two red lights, constitutes a call-on aspect, operative only while the plant is under manual control. The upper three-light unit of a home signal conveys the same information as a block signal. Green and yellow lights in the lower unit designate main and diverging routes respectively and two red lights constitute a « stop » indication.

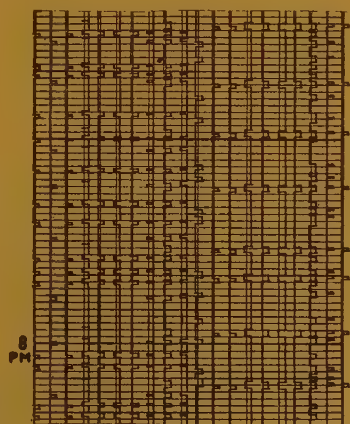


Fig. 4. — Reproduction of sample section of record chart.

Signals, relay cases and train-stop mechanisms are supported on steel beams riveted to the track girders. This construction permits track tie renewal without interference with signal equipment, and aids also in reducing the effects of severe vibration encountered on the elevated structures. Vibration effects are further mitigated by the use of spring supports for all stop mechanisms and all relay equipment, both inside and outside of the tower.

Wire and cable.

Aerial, braid-covered, rubber-insulated cables tied, with 5/32-inch tarred hemp marlin, to a 5/16 inch stranded, Copperweld messenger, attached to the elevated structure, are used for signal control circuits. All cable and single wire conductors consist of 19-strand flexible wires.

Track-circuit leads consist of single No. 6 A.W.G. conductors connected by bronze compression-type terminals to double-stranded steel bootleg bonds welded into 3/8-inch plugs.

Alternating current power for signal equipment at Navy Street interlocking and adjacent block signals is supplied by a 110/55-volt, 5-kv-a. transformer connected to a 2 200-volt signal feeder, which parallels the Myrtle Avenue line structure. Current for operating the two electro-pneumatic switch mechanisms is obtained from a 14-volt nickel-iron-type storage battery, trickle charged by a full-wave, dry-plate rectifier. A similar rectifier supplies d.c. energy at 48 volts to the sequence-unit relay equipment. Two 600-volt motor-driven compressors provide the necessary air supply for operating the switch-throwing mechanisms.

Alarm and recording apparatus.

The frequency of train operation through Navy Street junction, and the consequent serious delays to traffic that would occur as a result of an interruption in the automatic-interlocking control system, rendered it advisable to provide a suitable trouble alarm and recording equipment to assist the maintenance forces. The alarm arrangement consists of a bell, together with red and green indicating lights, located in an adjacent signal tower at Brooklyn Bridge terminal, and so controlled from

Fig. 5. — The relays are housed in sheet-metal cases.

Navy Street tower as to give an immediate warning in case of low air pressure, a-c. power interruption or failure in the operation of the automatic control apparatus. The latter function is accomplished by means of three time-element relays, which close the alarm circuit whenever any one of the three home signals, governing train movements through the plant, fails to clear

within an interval of approximately four minutes, measured from the instant at which a train arrives at the point where a clear signal should be received. A four-minute time interval is normally sufficient to allow for the completion of conflicting train movements.

An additional check on the operation of the automatic control equipment is provided by an Esterline, 20-pen strip-chart time-recorder, driven by a 110-volt, 25-cycle synchronous motor. Each of the 20 pens is so connected, through contacts on relays and other apparatus, as to record the operating time characteristics of the most important control units involved in the route line-up for each train movement. Strip charts, 90 feet in length, are driven at a 6-inch per hour rate, thus requiring replacement at intervals of approximately one week. The permanent record so obtained enables the maintenance forces to make a quick analysis and determination of the cause, whenever trouble develops.

The automatic control equipment at Navy Street plant has been operating since October 23, 1934, handling traffic at the rate of approximately 496 trains a day, in each direction. At the present time, the automatic feature is used 16 hours daily. It is expected, however, that continuous automatic operation will be made effective at an early date.

The saving in operating expense, under the present 16-hour daily schedule, is equivalent to an annual interest rate, on the installation cost of the automatic system, of approximately 33 %. This percentage will, of course, be proportionately increased to approximately 47 %, when continuous automatic operation is made effective.

The saving attained by the Navy Street installation is fairly representative of the results obtained from all of the automatic interlocking applications made by the company during the last 12 years. Such projects, where feasible, are evidently well worth serious consideration.

[621.132.3 (.493)]

RECENT DEVELOPMENTS.

IN RAILWAY PRACTICE.

New 4-cylinder simple expansion 4-6-2 express locomotives, Belgian National Railways Company.

The Belgian National Railways Company has just put into service the first of a series of 15 *Pacific* locomotives, designed for hauling the more important express trains on its system. These locomotives were built by a Belgium Consortium including : Société John Cockerill; Les Forges, Usines et Fonderies de Haine-Saint-Pierre; Ateliers de Construction de la Meuse, and the Tubize division of Ateliers Métallurgiques.

These locomotives with the tenders are 24.40 m. (80 feet) long over buffers, have a wheelbase (tender included) of 20.97 m. (68 ft. 10 in.) and an overall height of 4.28 m. (14 ft. 1/2 in.). The total engine weight in working order is 124 t. (122 Engl. tons), and the tender weight 84 t. (82.7 Engl. tons). The adhesive weight is 70.5 t. (69.4 Engl. tons), and the tender carries 10 1/2 tons of coal and 38 m^3 (10 560 Br. gallons) of water.

The boiler pressure is 18 kgr. per cm^2 (256 lb. per sq. inch). The wide firebox is carried over the trailing carrying wheels; the grate area is 5 m^2 (53.8 sq. feet). The barrel is 6 m. (19 ft. 8 1/4 in.) between tube plates, and 1.80 m. (5 ft. 11 in.) in diameter : it is made of nickel steel. The boiler is fed by an ACFI feed water heater delivering 21 m^3 (4 620 Br. gallons) an hour, and a non lifting Friedmann injector as standby. The superheater is of the C. S. type with separate headers, with forged spear ends and spherical joints.

The locomotive has 4 equal cylinders in line on the bogie centre line. The cylinders are in pairs in cast steel bolted

together on the longitudinal centre line of the engine. They are fitted with cast iron liners and their initial diameter is 420 mm. (16 1/2 inches). The inclination of the cylinders is 3 %. The hollow cast steel piston heads have a cast iron ring cast on.

No tail rod is fitted; the stroke is 720 mm. (28 3/8 inches). Double admission 250 mm. (9 27/32 inches) diameter cast iron piston valves are fitted. The motion is conjugated, the inner valves being driven by horizontal rocking levers in front of the cylinders. The outside valve gear is of the Walschaerts type. The 3.30 m. (10 ft. 10 in.) long outside connecting rods drive the second pair of coupled wheels; the inside rods, 2 m. (6 ft. 6 3/4 in.) long, drive the leading crank axle, which is of the built-up type in five pieces, self-balanced by the 132 mm. (5 13/64 inches) thick webbs.

The different wheels are to the Belgian standard diameters : 0.90 m. (2 ft. 11 1/2 in.) for the bogies, 1.98 m. (6 ft. 6 in.) for the coupled wheels, and 1.067 m. (3 ft. 6 in.) for the trailing truck. The journals are 250 mm. (9 27/32 inches) diameter, and 258 mm. (10 5/32 inches) long. The carrying wheels, including those of the tender, are fitted with S. K. F. roller bearings. The coupled axle boxes are cast steel with pressed-in bronze bearings of the American type, with semi-cylindrical ends without cheeks. They are lubricated by a mechanical lubricator.

A second mechanical lubricator with an anti-carboniser lubricates the cylinders. A snifting valve, with a steam jet, cools the superheater elements and cylinders when running with the regulator closed.

The bar frames are 115 mm. (4 1/2 inches) thick. A self-centering bogie, of the Delta constant resistance rocker type, is fitted at the leading end. A bissel truck of the same type forms the frame of the trailing truck.

The boiler is fastened at the front end on the inside cylinders, and is supported half way along by vertical flexible plates. The front end of the firebox rests on the front of the bissel truck. The springs are over the axle boxes and the hangers are built up of flat links. The coupled and trailing wheel springs are equalised to give three-point suspension, the load being transmitted to the bogie through its centre pin.

The locomotive and tender will take a 120-m. (6 chains) radius curve.

Automatic and direct air brakes, compressed air sanders, « Superior » soot blowers, and a « Teloc » speed recorder are fitted, and a « Pyle » turbo-generator provides the electric light required.

The domes, feed water heater, sanders, and pipes are covered over with an oval shaped casing ending at the leading end in two smoke lifter screens and merging at the trailing end into the cab. The raised sides of the tender continue this casing, the gap between the engine and the tender being as small as possible. An attempt has thus been made to streamline the whole of the engine and tender, at least in the top part.

MISCELLANEOUS INFORMATION.

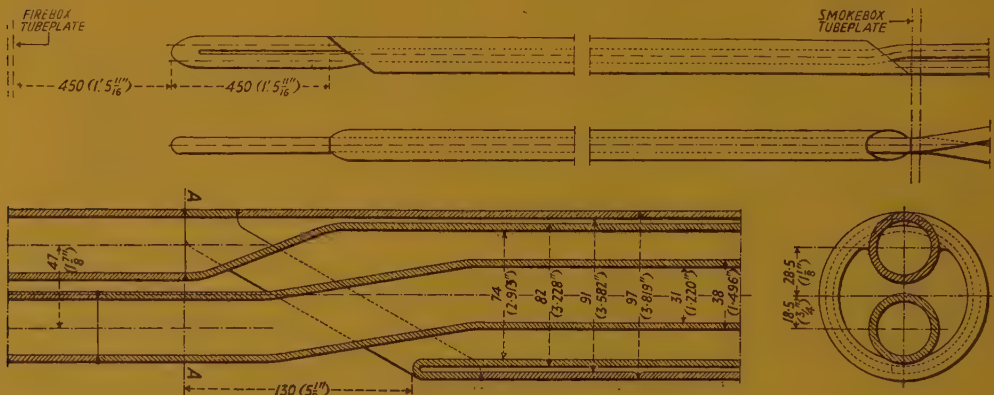
[621.134.3]

New French superheaters.

Latest type of Houlet annular superheater.

(The Railway Gazette.)

The distinctive feature of the Houlet annular superheater is the circulation of steam in a thin layer between two streams of hot gases, thus securing a rapid and effective transference of heat. In principle the construction is simple, steam flowing through an annular space between concentric tubes and returning through a smaller tube mounted



Longitudinal section showing detail of loop connection at firebox end of element.

Section A-A

Fig. 1. — Houlet annular superheater element with Louvroil and Recquignies patent system of loop connection. Latest pattern as fitted on the latest rebuilt 4-8-0 and 4-6-2 locomotives of the Paris-Orleans—Midi Railways.

Fig. 2. — Top : Annular superheater element in process of assembly, before welding-on the loop at the firebox end. — Centre : Detail of the welded loop connection at the firebox end of a Houlet superheater element (Louvroil and Recquignies patent construction). — Bottom : Complete annular superheater element as built by the Société Vallourec (Paris).

inside the other two. The practical difficulty of connecting the annular space to the header at one end, and to the return pipe at the other is overcome by the use of welded joints as shown in the accompanying illustrations. The construction illustrated is that employed by the Société Vallourec (6, Rue Daru, Paris), under the Louvroil and Recquignies patent, the welded joints being so disposed that they are not subjected to bending.

An important advantage of the new superheater is that its substitution for other types enables the superheat to be increased without reducing the steaming capacity of the boiler. This is not true of certain other methods, which have been tried for improving insufficient superheating. For example, the use of larger flues, the use of smaller superheater tubes, and the bushing of evaporating tubes at the tube plate, are all designed to increase the quantity of gas flowing over the superheater elements. This necessarily reduces the quantity of gas flowing through the evaporating tubes, and the reduction in the rate of steaming may more than counterbalance the increased superheat and result in lower overall efficiency. Where the annular superheater is employed, however, extra superheating surface is obtained without altering the distribution of gas flow between tubes and flues. Consequently, more heat is recovered from the gases in the flues, the rate of steaming is maintained, and the overall efficiency of the boiler is increased. It is possible either to increase the power for given fuel consumption or to reduce fuel consumption for given power developed.

The statements made in the preceding paragraph may be illustrated by reference to the accompanying table, which shows that a 125/133 mm. (4 15/16-5 1/4 in.) flue can accommodate a Schmidt type superheater element with a heating surface of about 40 sq. dm. per metre run (1.31 sq. ft. per ft. run), or an annular superheater element with a heating surface exceeding 60 sq. dm. per metre run (1.97 sq. ft. per ft. run), with practically the same passage for gas flow in both cases. Compared with the Schmidt superheater, the annular type therefore permits : (1) Higher

Comparison between Schmidt and annular superheaters in flues of 125 mm. (4 15/16 in.) internal diameter.

	Schmidt		Annular	
	With 31/38 mm. *(1.220/1.496 in.)* tubes	With 28/35 mm. *(1.102/1.378 in.)* tubes	With 31/38 mm. *(1.220/1.496 in.)* return	With 28/35 mm. *(1.102/1.378 in.)* return
Steam flows through . . .	Tube 31/38 mm. *(1.220/1.496 in.)* dia.	Tube 28/35 mm. *(1.102/1.378 in.)* dia.	Annular space between tubes 91/97 mm. (3.582/3.819 in.) and 74/82 mm. (2.913/3.228 in.) dia.	
Steam returns through . .	Do.	Do.	Tube 31/38 mm. *(1.220/1.496 in.)* dia.	Tube 28/35 mm. *(1.102/1.378 in.)* dia.
Weight	11.835 kgr./metre run *(7.95 lb./ft. run)*	10.806 kgr./metre run *(7.26 lb./ft. run)*	17.515 kgr./metre run *(11.77 lb./ft. run)*	17.258 kgr./metre run *(11.60 lb./ft. run)*
Heating surface, mean developed	43.36 sq. dm./metre run *(1.42 sq. ft./ft. run)*	39.58 sq. dm./metre run *(1.30 sq. ft./ft. run)*	65.03 sq. dm./metre run *2.13 sq. ft./ft. run)*	64.086 sq. dm./metre run *(2.10 sq. ft./ft. run)*
Average weight of one element for a tube length of 4.40 m. (14 ft. 5 1/4 in.)	50 kgr. *(110 lb.)*	46 kgr. *(101 lb.)*	70 kgr. *(154 lb.)*	68 kgr. *(150 lb.)*
Area of passage for hot gases	0.7736 sq. dm. *(11.99 sq. in.)*	0.8424 sq. dm. *(13.06 sq. in.)*	0.8029 sq. dm. *(12.44 sq. in.)*	0.8221 sq. dm. *(12.74 sq. in.)*
Area of steam passage, flow	0.0755 sq. dm. *(1.17 sq. in.)*	0.0615 sq. dm. *(0.95 sq. in.)*	0.1222 sq. dm. *(1.89 sq. in.)*	0.1222 sq. dm. *(1.89 sq. in.)*
Area of steam passage, return	0.0755 sq. dm. *(1.17 sq. in.)*	0.0615 sq. dm. *(0.95 sq. in.)*	0.0755 sq. dm. *(1.17 sq. in.)*	0.0615 sq. dm. *(0.95 sq. in.)*

superheat with the same number of elements, without reduction in steaming; or (2) increased steaming with the same superheat from a smaller number of elements, some of the latter being replaced by additional evaporating tubes.

Hitherto, the applications of the Houlet superheater by five great French railways have been for the purpose of increasing the superheat while maintaining the rate of steaming. In this, they have been consistently successful, the increase in steam temperature ranging from 35 to 50° C. (63 to 90° F.), given a maximum temperature of about 400° C. (750° F.), compared to the usual 375-385° C. (718-730° F.), other factors being equal. This corresponds to a net saving of fuel of nearly 10 %, a result confirmed by service trials. In every case, the substitution of the annular superheater elements involved no alterations in the tubing of the boilers and no change in the existing superheater headers. It is claimed that the new type can be fitted with equal ease in the flues of any existing locomotive, the superheater elements alone requiring to be changed.

NEW BOOKS AND PUBLICATIONS.

[625. 215]

LIECHTY (Roman). Engineer. — **Das bogenläufige Eisenbahnfahrzeug** (*The railway vehicle and its ability to negociate curves*). — One volume (11 3/4 × 1/4 inches) of 68 pages, with 88 figures. — 1934, Zurich, Schulthess & Co., publisher, Zwingliplatz, 2. (Price : 10 Swiss francs.)

Opinions are divided as to the usefulness and effectiveness of devices by which the axles under railway vehicles automatically adjust themselves to the curve, from the point of view of better riding and less tyre and rail wear. The question was the subject of much research work, the results of which are scattered in the technical literature; it is difficult to bring it down to common fundamental principles, and the author set himself this task in writing his very complete pamphlet on the arrangements in question.

The book begins by describing the systems in which the position of the axle is controlled by the couplings. This class includes, amongst others, the designs in which the radial adjustment of the axles is governed by the relative position of the locomotive and the tender coupled up to it. He then considers the systems in which the position is governed by centrifugal force, which methods do not appear to have remained in practical use.

Some of the chapters are devoted to the theory of the vehicle with two adjustable axles, either independent or coupled, and to describing the various types of vehicles with three free flexible coupled axles. The author then gives the theory of the bogies with two parallel axles and analyses the influence of the spring gear and of the type of body on the riding qualities of two-bogie vehicles and the way they negotiate curves.

An interesting class of vehicle is the eight-wheeled, the principle of which is that the two inner pairs of wheels free to move transversely and not taking up a radial position control the radial adjustment of the axles at the ends. Articulated units made up of two or three coaches in which the radial adjustment of the axles is obtained in much the same way, belong to this class.

The last chapter studies the control of the axles by two-wheeled trucks, and the pamphlet ends with a full bibliography of everything published in all the different languages on the running of railway vehicles through curves.

A. C.

[656. 225]

The Container, *Bulletin of the International Container Bureau*, published under the auspices of the International Chamber of Commerce, 38, Cours Albert I^er^, Paris. — Number 2, September 1934, 26 pages with illustrations.

The first issue of this publication appeared in January 1934, and was reviewed in the June 1934 number of the *Bulletin*, in which we told our readers that *The Container* was the official journal of the *International Container Bureau*. The first number contained the rules and regulations of the new inter-

national organisation and, together with some very interesting studies and information, already published certain decisions arrived at in the matter of standardising containers, and the conditions under which they were to be used in international traffic.

Bulletin No. 2 gives information about the more important developments in the matter, that have occurred recently.

Documentary articles on France, Great Britain, and Italy prove the recent progress in the use of containers.

This bulletin also contains a comparative study on the use of closed containers and covered wagons.

An appendix, by Senator Silvio Crespi, gives a description borne out by beautiful and suggestive photographic views of the Italian Sicon Company's two different container handling systems. The first system makes use of an electric lift truck in conjunction with hand trucks; the second uses a petrol tractor and trailers by which the container can be delivered to its destination. Bulletin No. 2 gives a detailed review of the loading and unloading tests on refrigerator containers, made with these devices on the 4th September 1934, at Bercy-la-Rapée station, on the Paris-Lyons-Mediterranean Railway.

Finally, the official information given in this second number includes the decisions arrived at as regards the simplification of the technical conditions to be fulfilled by the containers to allow of their use in international traffic.

This brief summary will be sufficient, we are sure, to show the great interest of this new number, and furthermore the need for those concerned with the construction and utilisation of countainers to be cognizant with this information.

E. M.

MONTHLY BIBLIOGRAPHY OF RAILWAYS (1).

PUBLISHED UNDER THE SUPERVISION OF

P. GHILAIN,

General Secretary of the Permanent Commission of the International Railway Congress Association.

JANUARY (1935)

016. 385. (02]

I. — BOOKS.

In French.

934 621 .3

JTHILLON (L.) et GOUDONNET.

ours pratique d'électricité industrielle.

aris, Gauthier-Villars. 1 volume (13 × 20.5), 306 pa- et figures. (Prix : 26 fr. français.)

934 69

omptes rendus des séances du Centre d'études supé- res de l'Institut technique du Bâtiment et des Tra- x publics.

aris (VI^e), Institut technique du Bâtiment et des vaux publics, 100, rue du Cherche-Midi. 2 volumes, emble 486 pages, 4 planches et 223 figures. (Prix : 2 volumes, 65 fr. français.)

934 691

ÉRILLOT.

rotection des métaux contre la corrosion.

aris (VI^e), J. E. Baillière et Fils, 19, rue Haute- lle. 1 volume (13.5 × 20.5), 200 pages et figures. ix : 25 fr. français.)

934 669 .1

LLET (L.).

a cémentation des produits métallurgiques et sa éralisation. Tome I : **Cémentation des aciers par le one.**

aris (VI^e), Dunod, 92, rue Bonaparte. 1 volume × 25), 373 pages et 302 figures. (Prix : 110 fr. içais.)

934 38 (.44)

ndicateur de la production française.

aris (VIII^e), Association Nationale d'Expansion nomique, 23, avenue de Messine. 1 volume, 512 pag.

934 62. (02

'Agenda Béranger pour 1935.

aris (VI^e), Librairie Polytechnique Ch. Béranger, rue des Saints-Pères. 1 volume (9 × 14), 371 pages. ix : 16 fr. français.)

1934 721 .9

LEDENT (G.).

Tables de calcul direct des sections en béton armé.

Paris, Peigues, 56, rue Notre-Dame-des-Champs. 1 brochure, 40 pages et 30 tableaux. (Prix : 20 fr. français.)

1934 621 .8

LEGRAS.

La manutention mécanique.

Paris, Armand Colin, 103, boulevard St-Michel. 1 volume, 220 pages et figures.

1934 62. (01 & 69

MAGNEL (G.).

Cours de stabilité des constructions.

Gand, Van Rysselberghe et Rombaut, 1, place d'Armes. 2 volumes, en tout 814 pages et 552 figures. (Prix : les 2 volumes, 330 fr. belges.)

1934 691

MOREAU (Ch.).

Le matériel moderne des travaux publics. Tome I : Terrassements.

Paris, Librairie de l'enseignement technique. 1 volume (16 × 24), 376 pages, 330 planches et figures. (Prix : 90 fr. français.)

In German.

1934 691

MARQUARDT (E.).

Beton- und Eisenbetonleitungen, ihre Belastung und Prüfung.

Berlin, Wilhelm Ernst & Sohn. 1 Band, 99 Seiten mit 65 Abbildungen. (Preis : 10 R.M.)

1934 625 .248 (.43) & 656 .213 (.43)

WALTER (K.).

Die Technik und Wirtschaft der Hygiene im Tierversand bei der Deutschen Reichsbahn.

Berlin, Verkehrswissenschaftliche Lehrmittelgesellschaft m. b. H. bei der Deutschen Reichsbahn. 1 Band, 216 Seiten, 1 Karte und Abbildungen.

(1) The numbers placed over the title of each book are those of the decimal classification proposed by the Railway Congress njointly with the Office Bibliographique International, of Brussels. (See « Bibliographical Decimal Classification as applied to ilway Science », by L. WEISSENBRUCH, in the number for November 1897, of the *Bulletin of the International Railway Congress,* 1509).

In English.

1934 625 .142.2 (06 (.73) & 691 (06 (.73)

AMERICAN WOOD-PRESERVERS' ASSOCIATION.

Proceedings of the thirtieth annual meeting held at the Rice Hotel, Houston (Texas), January 23-25, 1934. 523 pages.

1934 621 .13 (0 & 621 .43

LIPETZ (A. I.), consulting engineer, American Locomotive Company, Schenectady, N. Y.

Coming motive power and locomotive research. Paper read by the author at the Regular Meeting of the Canadian Railway Club, April 9th, 1934.

1934 621 .392

PATERSON (J. H.), D. Sc., F. I. C.

Handbook for electric welders.

London, E.17. Murex Welding Processes Ltd., Ferry Lane Works, Forest Road. 151 pages. (Price : 2 sh. 6 net.)

1934 69 (06 (.42) & 721. (06 (.4

Report of the Building Research Board for t year 1933.

London, Published by His Majesty's Stationery Offi 139 pages. (Price : 2 sh. 6 d. net.)

1934 69 (06 (.42) & 721. (06 (.4

Report of the reinforced concrete structures Comittee of the Building Research Board with recomme dations for a code of practice for the use of reinforc concrete in buildings.

London. Published by His Majesty's Stationery Offi 69 pages. (Price : 1 sh. 3 d. net.)

[016. 385. (05]

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1934 656 .223.2

Bull. de l'Union intern. des ch. de fer, octobre, p. 343.

PETRORO (L.). — **De la redevance de location pour l'emploi réciproque du matériel roulant et de son influence sur l'utilisation des wagons échangés en trafic international.** (15 500 mots.)

Bulletin technique de la Suisse romande. (Vevey.)

1934 665 .882

Bull. techn. de la Suisse romande, n° 22, 27 octobre, p. 253; 10 novembre, p. 269.

MEUNIER (F.). — **Sur la corrosion des soudures.** (3 100 mots & fig.)

Chronique des transports. (Paris.)

1934 656 (.44)

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La coordination du rail et de la route. Les « pactes » de Lille et de Valenciennes. (2 000 mots.)

1934 656

Chronique des transports, n° 21, 10 novembre, p. 3.

La coordination du rail et de la voie navigable. L'accord du Rhône. (2 500 mots.)

Génie civil. (Paris.)

1934 6

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PORTEVIN (A.) et HERZOG (E.). — **Quelqu conditions à réaliser dans les essais de corrosion d aciers en milieu humide.** (900 mots.)

1934 656 (.4

Génie civil, n° 2725, 3 novembre, p. 418.

MESTRE (A.). — **Réglementation préfectorale transports en commun en France.** (1 700 mots.)

1934 624

Génie civil, n° 2726, 10 novembre, p. 433; n° 27 17 novembre, p. 452.

BATICLE (E.). — **L'amélioration de la rigidité ponts suspendus.** (6 000 mots & fig.)

1934 625 .211. (.7

Génie civil, n° 2726, 10 novembre, p. 442.

La fabrication, aux Etats-Unis, des châssis en ac moulé pour matériel roulant. (900 mots & fig.)

1934 656 .256.3 (.4

Génie civil, n° 2727, 17 novembre, p. 449.

CHOUQUET (C.). — **L'installation du block au matique à signaux lumineux, entre Caen et Cherbou** (2 700 mots & fig.)

1934 621 .

Génie civil, n° 2728, 24 novembre, p. 473.

ANTONI (A.). — **La rectification et les machines rectifier sans centres.** (6 700 mots & fig.)

1934 624 .63 (.44)
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MEO (G.). — Observations faites à l'occasion de la nstruction du **pont en béton armé** de la Citadelle, Strasbourg. (3 000 mots & fig.)

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Examen des méthodes étrangères sur la **coopération rail et de la route.** (3 000 mots.)

1934 621 .13 (.73)
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La **durée de service des locomotives** à **vapeur** aux ats-Unis. (3 000 mots & fig.)

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SPIESS (E.). — **Locomotives de manœuvre Diesel-ectriques.** (5 400 mots & fig.)

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Amortisseurs en caoutchouc (pour appareils de choc de traction). (3 000 mots & fig.)

1934 625 .212
s Chemins de fer et les Tramways, octobre, p. 246.
Roues élastiques. (2 800 mots & fig.)

1934 625 .251
s Chemins de fer et les Tramways, octobre, p. 249.
Dispositif de **rattrapage automatique de jeu pour le einage.** (6 300 mots & fig.)

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s Chemins de fer et les Tramways, octobre, p. 234.
DESGARDES. — **Attelage pour tramways.** (900 mots fig.)

1934 625 .13
s Chemins de fer et les Tramways, novembre, p. 256.
Souterrains en terrains aquifères et éboulеux. (1 800 ots & fig.)

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Locomotives Diesel. (2 700 mots & fig.)

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La **chauffe au pulvérisé et à l'huile lourde.** Etat ctuel de la question sur les différents réseaux dans monde. (1 800 mots.)

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s Chemins de fer et les Tramways, novembre, p. 267.
Réglage automatique de la timonerie des freins. 5 400 mots & fig.)

1934 625 .214
Les Chemins de fer et les Tramways, novembre, p. 271.
Quelques applications des **roulements à aiguilles** dans les « transports en commun ». (1 800 mots & fig.)

1934 625 .142.3
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Procédé de fabrication de **traverses métalliques.** (1 800 mots & fig.)

1934 625 .162 (.44) & 656 .211 (.44)
Les Chemins de fer et les Tramways, novembre, p. 276.
DUCHESNOY. — La **reconstruction de la gare** de Vanves. (3 200 mots & fig.)

Les transports automobiles. (Paris.)

1932 656
Les transports automobiles, septembre-octobre, p. 18.
PAHIN (L. A. H.). — Le transport des marchandises par route ou par rail. **Concurrence ou coordination ?** (2 600 mots.)

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Les transports automobiles, novembre-décembre, p. 34.
A propos de quelques **charges fiscales** supportées par les usagers de la route et du rail. (1 700 mots.)

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Les transports automobiles, janvier-février, p. 47.
A propos du **remplacement des trains** de certaines lignes secondaires de chemins de fer **par des services automobiles.** (2 600 mots.)

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Les transports automobiles, juillet-septembre, p. 99.
ROUSSEAU (H.). — L'organisation de la **Société de transports auxiliaires** du réseau Paris-Orléans en Corrèze. (2 500 mots.)

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Les transports automobiles, octobre-mars, p. 117.
RENAUD (F.). — Le **nickel** dans l'automobile et dans les chemins de fer. (2 400 mots & fig.) (A suivre.)

1933-1934 656 .1 (.44)
Les transports automobiles, octobre-mars, p. 129.
LAVOIEPIERRE (P.). — Les **services automobiles** des chemins de fer français en 1932. (700 mots & 2 tableaux.)

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La **réglementation** des transports automobiles en Suisse. (2 000 mots.)

L'Industrie des voies ferrées et des transports automobiles. (Paris.)

1934 656
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La **coordination** des transports ferroviaires et routiers. (2 300 mots.)

L'Industrie du pétrole. (Paris.)

1934 **621 .133.1 & 656 .215**
L'Industrie du pétrole, octobre, p. 12.
BOCCACCIO (P.). — **Le pétrole d'éclairage** dans les chemins de fer. (1 200 mots.)

L'Ossature métallique. (Bruxelles.)

1934 **624 .62 (.493)**
L'Ossature métallique, novembre, p. 543.
Les **ponts-rails** d'Herenthals et de Malines à poutres Vierendeel. (400 mots & fig.)

1934 **625 .23 (.493)**
L'Ossature métallique, novembre, p. 560.
Les **voitures métalliques** nouvelles pour trains de banlieue de la Société Nationale des chemins de fer belges. (700 mots & fig.)

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WELTER (J.). — L'évolution de l'acier à haute résistance pour **constructions métalliques.** (15 000 mots, 2 tableaux & fig.)

Revue économique de Bordeaux. (Bordeaux.)

1934 **656**
Revue économique de Bordeaux, juillet-septembre, p. 61.
BARRAUD (P.). — Le régime de la concession en matière de **transports en commun.** (2 700 mots.)

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COCHET. — **Reconstruction du pont** de la Quarantaine sous les voies ferrées du P. L. M., à Lyon et de ses ouvrages d'accès. (4 500 mots & fig.)

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Revue générale des chemins de fer, novembre, p. 334.
SERVONNET. — Les **rames automotrices** rapides du Chemin de fer du Nord. (6 500 mots & fig.)

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GARAU. — Appareil Delprat & Durand destiné à mesurer les **oscillations horizontales des ouvrages.** (2 800 mots & fig.)

Revue universelle des Mines. (Liége.)

1934 **621 .94**
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BODART (E.). — Note sur quelques-uns des facteurs qui agissent sur la rugosité des **pièces tournées.** (2 500 mots, 4 tableaux & fig.)

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MOTCHAROFF (N. M.) & SOKOLOFF (A. S.). -
Mécanisation du **contrôle de la dépense en combustib** et du **parcours des locomotives.** Compteurs pour loc motives « Rona ». (3 800 mots & fig.)

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SZTOLCMAN (S.). — **Calcul des dépenses d'explo** tation des chemins de fer projetés. (2 500 mots 2 tableaux.) (A suivre.)

1933 **625 .21**
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ZEHNDER (R.). — L'état actuel de la question d l'**attelage automatique** des véhicules de chemins de fe en Europe. (5 000 mots.)

In German.

Die Lokomotive. (Wien.)

1934 **621 .132.3 (.44**
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Über den **Wettbewerb** zwischen Schienen- un Strassenverkehr in den Vereinigten Staaten von Ame rika. (2 000 Wörter.)

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Die Lokomotive, Oktober, S. 192.
Die Entwicklungsrichtung der **elektrischen Zugbefö derung** in den Vereinigten Staaten von Amerika. (1 00 Wörter.)

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Die Lokomotive, November, S. 206.
Die **Hochdrucklokomotive, Bauart Schmidt** der P.L.M und ihre Betriebsergebnisse. (4 000 Wörter & Abb.)

Glasers Annalen. (Berlin.)

1934 **625 .16**
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ERMENE (K.). — Über **Zugförderungsdienst un Streckensicherung** im Karst. (2 300 Wörter & Abb.)

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1934 **625 .151 (.43) & 625 .18 (.43)**
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BURGER (W.). — Die **Weichenwerkstätte** des Reichsbahn-Ausbesserungswerkes Neuaubing. (9 900 Wörter & Abb.)

1934 **621 .135.2 (.73), 625 .214 (.73) & 669 .1 (.73)**
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WITTE. — **Lagermetalle** im Eisenbahnwesen der Vereinigten Staaten. (1 000 Wörter & Abb.)

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DERIKARTZ. — Verkehrswissenschaftliche Tagung im « Haus der Technik » Essen vom 11. bis 13. Oktober 1934. **Das deutsche Verkehrswesen unter der Neuordnung.** (6 300 Wörter.)

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VELTE. — Der **Brennstoffverbrauch** je Lokomotivleistungstonnen-kilometer als Leistungsmesser für die Brennstoffwirtschaft bei Dampflokomotiven. (7 000 Wörter & Abb.)

Zeitschrift des Vereines Deutscher Ingenieure. (Berlin.)

1934 **656 .1 (.43)**
Zeitsch. des Ver. deutsch. Ing., Nr. 43, 27 Oktober, S. 1265.
WESTMEYER (R.). — Die **Neuordnung der deutschen Landstrassenverwaltung.** (3 000 Wörter & Abb.)

1934 **656 .1 (.43)**
Zeitsch. des Ver. deutsch. Ing., Nr. 45, 10. November, S. 1305.
TODT (F.). — Die **Reichsautobahnen** und ihre Aufgaben. (3 900 Wörter & Abb.)

1934 **656 .2**
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LEIBBRAND (M.). — Die Weiterentwicklung des **Verkehrs auf der Schiene.** (6 400 Wörter.)

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DANTSCHER (K.). — Die Wasserstrassen und das **deutsche Verkehrsproblem.** (3 600 Wörter.)

1934 **669 & 625 .62**
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BENNINGHOFF (W.). — **Aluminium** als Baustoff für die elektrische Ausrüstung der Strassenbahn. (1 200 Wörter.)

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1934 **656 .257**
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REHKEMPER (B.). — Pufferbetrieb im **Stromversorgungsanlagen** für Kraftstellwerke. (7 000 Wörter & Abb.)

Zeitung des Vereins mitteleuropäischer Eisenbahnverwaltungen. (Berlin.)

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MANTEY. — Die **Einkaufsorganisation** der Reichsbahn. (1 900 Wörter.)

1934 **385 .113 (.485)**
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PASZKOWSKI. — Die **Swedische Staatsbahn** im Jahre 1933. (2 300 Wörter.)

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BERGHAMMER. — Die **Bäseler-Hemmschuhbremse.** (2 000 Wörter & fig.)

1934 **385 .04**
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RINTELEN. — **Selbstmehrkosten** und **Werkmehrkosten.** (3 200 Wörter.)

1934 **656 (.43)**
Zeitung des Vereins mitteleuropäischer Eisenbahnverwaltungen, Nr. 45, 8. November, S. 801.
BURGER. — **Reichsbahn-Kraftverkehr** und Gesetzgebung. (2 400 Wörter.)

1934 **656 (.43)**
Zeitung des Vereins mitteleuropäischer Eisenbahnverwaltungen, Nr. 46, 15. November, S. 817.
TRIERENBERG. — **Reichsbahn und Verkehrswirtschaft** im nationalsozialistischen Staat. (4 200 Wörter.)

1934 **385 .59 (.43) & 656 .285 (.43)**
Zeitung des Vereins mitteleuropäischer Eisenbahnverwaltungen, Nr. 46, 15. November, S. 822.
MARTENS (A.). — **Persönliche Sicherheit** des Bahnhofs- und Streckenpersonals gegen Züge mit Hochgeschwindigkeiten. (1 800 Wörter.)

1934 **385 .09 : (.68)**
Zeitung des Vereins mitteleuropäischer Eisenbahnverwaltungen, Nr. 47, 22. November, S. 837.
MEYER (H. K.). — Reiseeindrücke von den **Eisenbahnen Südafrikas.** (4 000 Wörter, 1 Karte & Abb.)
(Schluss folgt.)

In English.

Bulletin, American Railway Engineering Association. (Chicago, Ill.)

1934 625 .1 (02 & 625 .1 (06
Bull., Amer. Ry. Engineering Ass., July-August, p. 1.
Revisions and additions to the Manual approved at the annual meeting of the Association, March 13 and 14, 1934.

Engineer. (London.)

1934 621 .115
Engineer, No. 4111, October 26, p. 404; No. 4112, November 2, p. 428; No. 4114, November 16, p. 491.
The surface condenser. (6 000 words and fig.)

1934 313 :656.1 & 313 :656.28 (0
Engineer, No. 4111, October 26, p. 406.
WALTON (D. W.). — The statistical study of road **accidents.** (3 000 words.)

1934 621 .31 (.42)
Engineer, No. 4111, October 26, p. 410.
The Galloway **water power** scheme. (2 500 words and fig.)

1934 621 .31
Engineer, No. 4111, October 26, p. 417.
High rupturing capacity fuses. No. I. (3 700 words and fig.)

1934 669 .1
Engineer, No. 4111, October 26, p. 419.
HATFIELD (W. H.). — **Steel castings.** (5 000 words and fig.)

1934 62. (01 & 621 .88
Engineer, No. 4112, November 2, p. 429.
PULLIN (V. E.). — **Radiographic examination of rivets.** (1 500 words and fig.)

1934 621 .31
Engineer, No. 4112, November 2, p. 433.
High rupturing capacity fuses. No. II. (2 400 words and fig.)

1934 621 .43 (064 (.42)
Engineer, No. 4112, November 2, p. 440.
The **Motor Show** at Olympia, London. (2 200 words and fig.)

1934 621 .94 (.42)
Engineer, No. 4112, November 2, p. 444.
New tramway wheel and axle lathe. (1 400 words.)

1934 621 .138
Engineer, No. 4113, November 9, p. 461.
Repairs in the **running shed.** (1 200 words.)

1934 536
Engineer, No. 4113, November 9, p. 464.
Third International Steam Tables Conference. (800 words.)

1934 621 .392
Engineer, No. 4113, November 9, p. 467.
A projecting **welding press.** (600 words and fig.)

1934 621 .165 & 621 .18
Engineer, No. 4113, November 9, p. 469.
High-pressure steam turbine plants. (200 words and 1 table.)

1934 621 .9 (.064 (.42)
Engineer, No. 4113, November 9, Suppl. p. I; No. 4114, November 16, Suppl. p. I.
The Machine Tool and Engineering Exhibition.

1934 621 .43
Engineer, No. 4114, November 16, p. 476.
DAVID (W. T.). — **Gaseous specific heats and internal combustion engine efficiencies.** (3 500 words, 3 tables and fig.)

1934 621 .116
Engineer, No. 4114, November 16, p. 479.
The Loeffler system of **steam production.** (3 000 words.)

1934 621 .31
Engineer, No. 4114, November 16, p. 482.
High rupturing capacity fuses. No. III. (2 400 words and fig.)

1934 621 .116
Engineer, No. 4114, November 16, p. 494.
McEWEN (S.). — The Loeffler system of steam pro**duction.** (4 800 words and fig.)

Engineering. (London.)

1934 621 .31 (.42) & 627 .82 (.42
Engineering, No. 3589, October 26, p. 429.
The **hydro-electric scheme** of the Galloway Wate Power Company. (4 500 words and fig.)

1934 656 .255 (.42
Engineering, No. 3589, October 26, p. 438.
Automatic braking system on the Post Office tub railway. (1 600 words and fig.)

1934 621 .11
Engineering, No. 3589, October 26, p. 453.
Recent developments in **steam boiler constructio** (3 600 words.)

1934 621 .31 (.437
Engineering, No. 3590, November 2, p. 457.
The Trebovice power station, Silesia, Czechoslovaki (3 600 words and fig.)

1934 62. (0
Engineering, No. 3590, November 2, p. 479.
5-ton self-indicating testing machine. (1 000 words an fig.)

34 621 .132.6 (.42)
ıeering, No. 3590, November 2, p. 482.
-2 type heavy tank locomotive, G. W. Ry. (300
and fig.)

34 621 .9 (064 (.42)
ıeering, No. 3591, November 9, p. 485; No. 3592,
ovember 16, p. 517.
e Machine Tool and Engineering Exhibition.
0 words and fig.)

34 621 .43
ıeering, No. 3591, November 9, p. 509.
Y (Ch.). — Early experiences with Diesel engine.
lential address delivered on November 2, 1934, at
nstitution of Mechanical Engineers. (4 500 words.)

34 669 .1
ıeering, No. 3591, November 9, p. 511.
TFIELD (W. H.). — Steel castings. (2 400 words
ig.)

34 621 .116
ıeering, No. 3592, November 16, p. 535.
EWEN (S.). — The Loeffler system of steam pro-
on. Paper read at the joint meeting of the Institu-
of Mechanical Engineers and the Institute of Fuel
ovember 9, 1934. (3 700 words.)

34 621 .116
ıeering, No. 3592, November 16, p. 546.
EWEN (S.). — The Loeffler system of steam pro-
on. (4 000 words.)

Engineering News-Record. (New York.)

34 627 .82 (.73) & 693 (.73)
ıeering News-Record, No. 15, October 11, p. 451.
EELE (B. W.). — Cooling Boulder dam concrete.
) words and fig.)

34 624 .2
ıeering News-Record, No. 15, October 11, p. 456.
ATTERS PAGON (W.). — Drag coefficients for
tures studied in wind-tunnel model tests. (1 800
s, 5 tables and fig.)

34 624 .63 (.73)
ıeering News-Record, No. 15, October 11, p. 467.
BE (W. H.) & OVERMAN (D. H.). — Long con-
-arch viaduct built near Cleveland. (2 300 words
fig.)

34 624 (.73)
ıeering News-Record, No. 16, October 18, p. 483.
MOTTE GROVER. — Continuous-girder viaduct
ıusual design. (2 000 words and fig.)

34 624 (0
ıeering News-Record, No. 16, October 18, p. 492.
RINTON (D. V.). — A study of job production on
road bridges. (2 400 words and 4 tables.)

1934 **691 & 693**
Engineering News-Record, No. 17, October 25, p. 523.
LERCH (W.). — **Heat of hydration of cement** by simple apparatus (1 500 words and fig.)

1934 **624. (0**
Engineering News-Record, No. 17, October 25, p. 532.
Long-span bridge development as seen by a British engineer. (1 500 words.)

Journal, Institution of Engineers, Australia. (Sydney, N. S. W.)

1934 **621 .6 & 669 .1**
Journal, Institut. of Engineers, Australia, September, p. 293.
WAITT (F. W. F.). — Maintenance and protection of **cast iron water pipes.** With special reference to economic factors. (7 700 words, 5 tables and fig.)

1934 **621 .31**
Journal, Institut. of Engineers, Australia, September, p. 305.
HAUGAARD (F. B.). — **Parallel operation of automatically controlled three phase induction voltage regulators and tap changing transformers.** (4 000 words and fig.)

Journal, Institute of Transport. (London.)

1934 **38**
Journal, Institute of Transport, November, p. 8.
GARCKE (S. E.). — The study of **passenger transport.** (4 000 words.)

1934 **313 :656**
Journal, Institute of Transport, November, p. 13.
WOOD (W. V.). — **Transport statistics.** Their uses and abuses. (3 800 words.)

Mechanical Engineering. (New York.)

1934 **627 .82 (.73)**
Mechanical Engineering, November, p. 647.
KINZIE (P. A.). — **Hydraulic valves and gates** for Boulder dam. Part IV. The design and construction. (6 900 words and fig.)

Modern Transport. (London.)

1934 **656 .254**
Modern Transport, No. 815, October 27, p. 3.
Supervision of railway operation. Securing efficiency from train control. (2 200 words.)

1934 **621 .43 (.54)**
Modern Transport, No. 815, October 27, p. 5.
Diesel-electric railcar for Indian mountain railway. (2 500 words and fig.)

1934 **625 .246 (.42)**
Modern Transport, No. 815, October 27, p. 8.
Welded wagons. (600 words and fig.)

1934 **621 .43 (.44)**
Modern Transport, No. 815, October 27, p. 9.
An improved « Micheline » railcar. Trials with 56-seater vehicle on the French State Railway. (1 800 words and fig.)

1934 **621 .33 (.54)**
Modern Transport, No. 815, October 27, p. 10.
Electrification of the Bombay suburban system. (1 100 words.)

1934 **621 .43 (.41)**
Modern Transport, No. 815, October 27, p. 11.
Pneumatic-tyred railbuses in Northern Ireland. (2 200 words and fig.)

1934 **621 .138**
Modern Transport, No. 816, November 3, p. 3.
Efficiency in railway operation. **Distribution of engine power.** (1 600 words and fig.)

1934 **621 .43 (.87)**
Modern Transport, No. 816, November 3, p. 5.
HASLAM (T. C. S.). — **Railcars** in Venezuela. (1 600 words and fig.)

1934 **621 .33 (.728.6)**
Modern Transport, No. 817, November 10, p. 3.
Railway electrification in Central America. The Pacific Railway of Costa Rica. (1 600 words and fig.)

1934 **621 .43 (.41)**
Modern Transport, No. 817, November 10, p. 6.
Railcars in Northern Ireland. (800 words and fig.)

1934 **625 .14 (01 (.42) & 656 .222.1 (.42)**
Modern Transport, No. 818, November 17, p. 5.
CARPMAEL (R.). — **Speed potentialities** of British Railways; Problems of track and traction. (2 000 words.)

1934 **625 .253 (.438)**
Modern Transport, No. 818, November 17, p. 9.
British **brakes** for Poland. (1 200 words and fig.)

1934 **656 .1 (.41)**
Modern Transport, No. 818, November 17, p. 10.
BALLANTYNE (J.). — **Railway-operated road transport.** (3 000 words and fig.)

1934 **347 .763 (.42)**
Modern Transport, No. 818, November 17, p. 12.
Transport control and regulations. Some facts and fallacies (1 900 words.)

Railway Age. (New York.)

1934 **621 .335 (.73) & 621 .43 (.73)**
Railway Age, No. 15, October 13, p. 427.
Union Pacific gets second **high-speed train. Six-car articulated Pullman-equipped** unit is built of aluminum and driven by a 900-hp. Diesel engine. (2 500 words and fig.)

1934 **625 .143.3 (.73) & 625 .245 (.7**
Railway Age, No. 15, October 13, p. 435.
Sperry detector car introduces pre-energization. (1 words and fig.)

1934 **614 .8 (06 (.7**
Railway Age, No. 15, October 13, p. 437.
Safety Section, A. R. A., meets in Cleveland. (6 words.

1934 **621 .33 (06 (.7**
Railway Age, No. 15, October 13, p. 441.
Electrical men, A. R. E. E., meet in Chicago. (3 words.)

1934 **385 .1 (.7**
Railway Age, No. 15, October 13, p. 444.
Federal Co-ordinator Eastman discusses **railr future.** (4 600 words.)

1934 **625 .232 (.7**
Railway Age, No. 16, October 20, p. 465.
Illinois Central rehabilitates its **passenger equipme** (2 000 words and fig.)

1934 **656 .211 (.73) & 725 .31 (.7**
Railway Age, No. 61, October 20, p. 468.
Southern Pacific completes **passenger terminal** Houston. (3 600 words and fig.)

1934 **621 .139 (.73), 625 .18 (.7 & 625 .27 (.7**
Railway Age, No. 16, October 20, p. 473.
CURTIS (D. C.). — Methods and problems of **railw supply forces.** (3 500 words and fig.)

1934 **385 .(072 (.7**
Railway Age, No. 16, October 20, p. 477.
Centralized scientific research. (6 000 words.)

1934 **385 (.7**
Railway Age, No. 17, October 27, p. 494.
DUNN (S. O.). — **The new deal in business, the deal in transport.** An address delivered before the I nois Chamber of Commerce at Chicago on October (6 600 words.)

1934 **621 .13, 621 .33, 621 .43 & 656 .22**
Railway Age, No. 17, October 27, p. 499.
WRIGHT (G. I.) & Mc PEE (P. A.). — **What mot power for high speeds ?** (4 700 words and fig.)

1934 **625 .1 (06 (.7**
Railway Age, No. 17, October 27, p. 508.
Bridge and Building Association holds meeting Chicago. (6 300 words.)

1934 **656 .261 (.7**
Railway Age, No. 17, October 27, p. 517.
Pennsylvania sells **storedoor service.** (1 600 words fig.)

1934 **656 .261 (.7**
Railway Age, No. 17, October 27, p. 519.
Canadian National Railways studies **storedoor serv** Part II. (2 300 words and fig.)

934 621 .133.7 (.73)
way Age, No. 18, November 3, p. 534.
oney spent for better **water brings large return.** 0 words and fig.)

934 621 .132.3 (.73)
way Age, No. 18, November 3, p. 537.
orthern Pacific receives **heavy passenger power.** 0 words, 1 table and fig.)

934 656 .2 (06 (.73)
way Age, No. 18, November 3, p. 543.
assenger Traffic Officers meet. **Advertising, solicion and development of passenger traffic** discussed at Louis convention. (5 500 words.)

Railway Engineer. (London.)

934 621 .9 (.42) & 621 .138.5 (.42)
way Engineer, November, p. 333.
ew machinery and appliances at Crewe works, L. M. y. (2 500 words & fig.)

934 621 .9 & 621 .138.5
way Engineer, November, p. 339.
olour control in railway workshops (1 300 words.)

934 621 .131.3 (.44)
way Engineer, November, p. 340.
LACE (P.). — The Vitry **locomotive-testing station** he French Railways. (3 000 words and fig.)

934 621 .143.3 (.73) & 665 .882 (.73)
way Engineer, November, p. 344.
econditioning battered rail-ends. (900 words.)

934 621 .9 & 621 .138.5
way Engineer, November, p. 345.
nprovements in the organisation and machine tool tice of **railway locomotive shops.** (4 800 words.)

934 621 .9 (064 (.42)
way Engineer, November, p. 349.
he machine Tool and Engineering Exhibition. Some he exhibits at Olympia. (16 000 words and fig.)

Railway Engineering and Maintenance. (New York.)

934 625 .1 (0
way Engineering and Maintenance, Novemb., p. 622.
standardization practical? (5 100 words and fig.)

934 625 .17 (.73)
way Engineering and Maintenance, Novemb., p. 627.
TIMSON (E.). — Where do we stand? What is present **condition of our tracks,** after four years of enchment following seven years of intensive erment? (2 800 words.)

934 625 .17 (.73)
way Engineering and Maintenance, Novemb., p. 630.
EECE (A. N.). — **Our maintenance departments**t they be reorganized? (3 200 words and fig.)

1934 625 .142 & 625 .17
Railway Engineering and Maintenance, Novemb., p. 633.
SCHRAM (I. H.). — **Tie renewals** demand most careful attention. (2 200 words and fig.)

1934 625 .1 (06 (.42)
Railway Engineering and Maintenance, Novemb., p. 635.
Bridge and Building men hold forty-first convention. (32 000 words.)

Railway Gazette. (London.)

1934 625 .234 (.73)
Railway Gazette, No. 16, October 19, p. 625.
MIALL (S.). — **Air conditioning** of trains — III. — Use of ice described. (1 200 words and fig.)

1934 721 .9 (.42)
Railway Gazette, No. 17, October 26, p. 668.
Concrete articles for railway use. (450 words and fig.)

1934 625 .246 (.42)
Railway Gazette, No. 17, October 26, p. 673.
A new light weight welded wagon. (400 words and fig.)

1934 656 .261 (.43 + .45)
Railway Gazette, No. 17, October 26, p. 679.
Transporting railway trucks by road. (700 words and fig.)

1934 621 .43 (.41)
Railway Gazette, No. 18, November 2, p. 693.
Pneumatic tyred railbus. (1 400 words and fig.)

1934 625 .244 (.931)
Railway Gazette, No. 18, November 2, p. 706.
New chilled beef vans, New Zealand Railways. (200 words and fig.)

1934 625 .232 (.42)
Railway Gazette, No. 18, November 2, p. 708.
The travelling Post Office in service. (250 words and fig.)

1934 656 .211 (.73) & 725 .31 (.73)
Railway Gazette, No. 19, November 9, p. 757.
The new **Pennsylvania stations** at Philadelphia. (2 200 words and fig.)

1934 625 .232 (.66)
Railway Gazette, No. 19, November 9, p. 762.
New **steel passenger coaches** for the Nigerian Railway. (1 000 words and fig.)

1934 621 .132.3 (.68)
Railway Gazette, No. 19, November 9, p. 795.
New **4-8-2 type locomotives** for South Africa. (1 100 words and fig.)

1934 625 .14 (01 (.42) & 656 .222.1 (.42)
Railway Gazette, No. 19, p. 808.
Speed of travel of the future. (2 400 words and fig.)

1934 **621 .43 (.460)**
Diesel Ry. Traction, p. 728, Supplt. to the Ry. Gazette, November 2.

Operating experience with **Diesel railcars** in Spain. (4 300 words and fig.)

1934 **621 .43**
Diesel Ry. Traction, p. 736, Supplt. to the Ry. Gazette, November 2.

MIALL (S.). — **Transmissions** for Diesel locomotives and railcars. Recent developments in Vulcan-Sinclair couplings for traction applications. (2 500 words and fig.)

1934 **621 .43**
Diesel Ry. Traction, p. 739, Supplt. to the Ry. Gazette, November 2.

A new **fluid transmission** for transport work. (700 words and fig.)

1934 **621 .43 (.439)**
Diesel Ry. Traction, p. 740, Supplt. to the Ry. Gazette, November 2.

Diesel **railcar** practice in Hungary. (1 500 words and fig.)

1934 **621 .43**
Diesel Ry. Traction, p. 744, Supplt. to the Ry. Gazette, November 2.

Mechanical transmissions for railcars. (1 500 words and fig.)

1934 **621 .33 (.47) & 625 .4 (.47)**
Electric Ry. Traction, p. 642, Supplt. to the Ry. Gazette, October 19.

The Moscow **underground.** (4 500 words and fig.)

1934 **621 .336**
Electric Ry. Traction, p. 648, Supplt. to the Ry. Gazette, October 19.

WHYMAN (F.). — **Overhead current collection with carbon wearing strips.** (1 200 words and fig.)

1934 **621 .33 (.52) & 625 .4 (.52)**
Electric Ry. Traction, p. 650, Supplt. to the Ry. Gazette, October 19.

Tokyo electric **underground railway.** (750 words and fig.)

1934 **621 .33 (.45)**
Electric Ry. Traction, p. 652, Supplt. to the Ry. Gazette, October 19.

KAAN (E. R.). — **Electrification** of the Austrian Federal Railways. (2 400 words and fig.)

1934 **621 .336 (.47)**
Electric Ry. Traction, p. 656, Supplt. to the Ry. Gazette, October 19.

Trials of **steel contact wire.** (500 words and fig.)

1934 **621 .33 (.42)**
Electric Ry. Traction, p. 824, Supplt. to the Ry. Gazette, November 16.

New British electrification schemes. (1 000 words and fig.)

1934 **621 .33 (.61)**
Electric Ry. Traction, p. 828, Supplt. to the Ry. Gazette, November 16.

Railway **electrification** in North America. (5 400 words and fig.)

Railway Magazine. (London.)

1934 **656 .222 (.42)**
Railway Magazine, November, p. 315.

British **express trains** in the Summer of 1934. (1 500 words and tables.)

1934 **656 .222.1 (.42)**
Railway Magazine, November, p. 323.

ALLEN (C. J.). — **British locomotive practice and performance.** (4 000 words and fig.)

1934 **385. (091 (.729)**
Railway Magazine, November, p. 335.

LOCKIE (G. R.). — **Railways** of the Dominican Republic. (1 600 words and fig.)

Railway Signaling. (Chicago.)

1934 **621 .31 & 656 .25**
Railway Signaling, October, p. 487.

Mercury-vapor rectifier tubes. (2 200 words and fig.)

1934 **625 .162 (.73) & 656 .254 (.73)**
Railway Signaling, October, p. 490.

Highway crossing protection of the barrier type. (2 500 words and fig.)

1934 **625 .151 (.73)**
Railway Signaling, October, p. 493.

Spring switches solve problem on Staten Island lines. (1 200 words and fig.)

1934 **656 .254 (.73) & 656 .255 (.73)**
Railway Signaling, October, p. 495.

ZANE (W. F.). — **Centralized traffic control** installed on the Burlington. (3 400 words and fig.)

1934 **625 .162 (.73) & 656 .254 (.73)**
Railway Signaling, October, p. 499.

Illinois to instal **grade-crossing protection** at State expense. (1 800 words and 1 table.)

1934 **625 .162 (.71) & 656 .254 (.71)**
Railway Signaling, October, p. 501.

Highway crossing protection on the Canadian Pacific. (1 400 words and fig.)

The Locomotive. (London.)

1934 **625 .214**
The Locomotive, November 15, p. 329.

Anti-friction bearings. (1 400 words.)

1934 **621 .131.2**
The Locomotive, November 15, p. 339.
PHILLIPSON (E. A.). — **Steam locomotive design : Data and formulae.** (800 words and tables.)

1934 **625 .215**
The Locomotive, November 15, p. 341.
Sheffield-Twinberrow type bogies. (1 300 words.)

1934 **625 .214**
The Locomotive, November 15, p. 344.
Improved axleboxes. (1 400 words and fig.)

1934 **621 .138.5 & 621 .9**
The Locomotive, November 15, p. 345.
Murray colour controls for machine tools. (3 200 words and fig.)

Transit Journal. (New York.)

1934 **388 (06 (.73)**
Transit Journal, October, p. 387.
Proceedings of First American Transit Association Annual Session (with exhibits) since 1931, Cleveland, 24-27 September 1934. (20 000 words.)

In Spanish.

Caminos de hierro. (Madrid.)

1934 **385**
Caminos de hierro, septiembre, p. 229.
MONREAL (M.) & CASTILLO (M.). — **La crisis ferroviaria y sus posibles remedios.** (1 200 palabras.) (Continuará.)

1934 **656**
Caminos de hierro, septiembre, p. 232.
La competencia en los transportes. (3 700 palabras & fig.)

Ferrocarriles y Tranvias. (Madrid.)

1934 **625 .13**
Ferrocarriles y Tranvias, octubre, p. 356.
CASADO (C. F.). — **Modelos de obras en pasos de carretera sobre ferrocarril.** (1 500 palabras & fig.)

1934 **625 .113**
Ferrocarriles y Tranvias, octubre, p. 362.
LEUCHS (F.). — **Nuevo procedimiento para el replanteo de curvas.** (1 200 palabras & fig.)

Ingenieria y Construcción. (Madrid.)

1934 **621 .43 (.73)**
Ingenieria y Construcción, octubre, p. 614.
El automotor aerodinámico del Unión Pacific Rail-road. (1 200 palabras & fig.)

Los Transportes. (Madrid.)

1934 **625 .26**
Los Transportes, nº 385, 1 de octubre, p. 296.
Averias de los vagones. (700 palabras & fig.)

Revista de Ingenieria Industrial. (Madrid.)

1934 **621 .135.3 & 625 .213**
Revista de Ingenieria industrial, octubre, p. 325.
LAFFITTE (C.). — **El funcionamiento de la suspensión de vehículos.** IV. — Vehículos empleados en la práctica de la locomoción. (3 000 palabras & fig.)

Revista de Obras Públicas. (Madrid.)

1934 **624 .9**
Revista de Obras Públicas, nº 21, 1º de noviembre, p. 402.
PRIETO MORESI (J. E.). — **Método de la propagación de momentos en las estructuras múltiples.** (4 200 palabras & fig.)

1934 **625 .113**
Revista de Obras Públicas, nº 22, 15 de noviembre, p. 423.
SALTO. — **Abacos para el trazado de curvas circulares.** (800 palabras & fig.)

In Italian.

Annali dei lavori pubblici. (Roma.)

1934 **621 .132.8**
Annali dei lavori pubblici, giugno, p. 519.
BAJOCCHI (U.). — **Sullo scalettamento delle locomotive a dentiera.** (5 600 parole & fig.)

La tecnica professionale. (Firenze.)

1934 **621 .131.3**
La tecnica professionale, novembre, p. 283.
CORBELLINI (G.). — **Esperimenti con locomotive funzionanti a regime constante.** (2 200 parole & fig.)

1934 **621 .133.7**
La tecnica professionale, novembre, p. 291.
MENGHI (S.). — **Le prove di collaudo e di controllo degli apparecchi di alimentazione di acqua in caldaia.** (3 900 parole & fig.)

Rivista tecnica delle ferrovie italiane. (Roma.)

1934 **624 .6**
Rivista tecnica delle ferrovie italiane, 15 ottobre, p. 225.
LO CIGNO (E.). — **Gli altissimi viadotti senza ordini intermedi di archi e senza pile spalle.** (7 000 parole, 4 quadri & fig.)

1934 **625 .23 (0 (.45)**
Rivista tecnica delle ferrovie italiane, 15 ottobre, p. 247.
NISSIM (R.). — **Le nuove carrozze metalliche a carrello delle Ferrovie Nord Milano.** (3 000 parole & fig.)

1934 621 .33

Rivista tecnica delle ferrovie italiane, 15 ottobre, p. 259.

CRUGNOLA (C.). — **Apparecchio registratore per la revisione delle linee di contatto trifasi.** (1 900 parole & fig.)

In Dutch.

De Ingenieur. (Den Haag.)

1934 624 .2 (.492) & 624 .63 (.492)

De Ingenieur, n° 44, 2 November, p. Bt. 85.

BAKKER (A.). — **Voetbrug** over de **Lusthofstraat** te Rotterdam. (1 700 woorden & fig.) (Wordt vervolgd.)

1934 656 (.494)

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WANNER (F.). — Das neue schweizerische **Verkehrsteilungsgesetz.** (7 200 woorden.)

1934 656 .1 (.492)

De Ingenieur, n° 46, 16 November, p. V. 77.

Het aandeel van het **motorwegverkeer** in de kosten van den weg. (2 400 woorden & fig.)

Spoor- en Tramwegen. (Utrecht.)

1934 656

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Is het **auto- en motorverkeer** mede schuldig aan de economische depressie ? (1 900 woorden.)

1934 621 .43 (.489)

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Uitbreiding van de **Dieseltractie** bij de Deensche Staatsspoorwegen. (1 000 woorden & fig.)

1934 621 .135.3

Spoor- en Tramwegen, n° 24, 20 November, p. 621.

LABRIJN (P.). — De **veerophanging van locomotieven.** (2 800 woorden, 1 tabel & fig.) (Wordt vervolgd.)

1934 385. (09.3 (.493)

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In Belgiën, honderd jaar geleden. (1 100 woorden & fig.)

In Polish.

(= 91.885)

Inżynier Kolejowy. (Warszawa.)

1934 621 .43 (.438) = 91 .885

Inzynier Kolejowy, n° 10, p. 236.

OGUREK. — Essai de l'**automotrice** fournie par l'usine H. Cegielski », à Poznan. (1 200 mots & fig.)

1934 621 .33 (.438) = 91 .885

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1934 621 .33 (.438) = 91 .885

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1934 385. (09 (.67)

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SOUSA (F. de). — **Caminhos de ferro** e Portos de Moçambique. (1 900 palavras.)

1934 625 .1 (.469)

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1934 385. (06.4 (.469)

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1934 621 .33

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In Rumanian.

(= 599)

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1934 656 (.498) = 599

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FEBRUARY (1935)

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Paris (Ve), Librairie de l'Enseignement technique Léon Eyrolles, 3, rue Thénard. 1 volume, 404 pages. (Prix : 45 fr. français.)

1934 621 .3

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1934 669 .1

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Paris, Dunod, 92, rue Bonaparte, 1 volume (16 × 25), 465 pages, 428 figures et planches. (Prix : 135 fr. français.)

1934 621 .116

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Paris et Liége, Ch. Béranger. 1 volume, 115 pages et 73 figures. (Prix : 30 fr. français.)

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1934 721 .9

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1934 72 (02

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1934 **624 .2**

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1934 **62. (01 & 624 .92**
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1934 **691**
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1934 **625 .13 (.42) & 625 .4 (.42)**
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1934 **669**
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Etude thermomagnétique de **l'hétérogénéité des solutions solides.** (1 600 mots & fig.)

1934 **669 .1**
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KERVOLEY (R.). — Quelle sera la politique de **l'autorail** en France et à l'étranger. (7 000 mots & fig.)

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Possibilités offertes par quelques **locomotives** françaises. (1 600 mots & fig.)

1934 **621 .43**
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SPIESS (C.). — **Train automoteur articulé** à six voitures de l'Union Pacific Railroad. (4 700 mots & fig.)

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CHARRIN (V.). — **Wagon autodéchargeur** à grande capacité pour les transports de potasse. (700 mots & fig.)

1934 **625 .212**
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DESGARDES (E.). — Note relative à **l'usure des bandages.** (2 000 mots & fig.)

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DUCHESNOY. — **Remisage pour automotrices.** (700 mots & fig.)

1934 **385. (01 (.66 + .67)**
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1934 **624 .2**

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1934 **721 .9**

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BLEICH (F.). — La théorie et la recherche expérimentale en **construction métallique.** (6 000 mots & fig.)

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1934 **725 .31 (.44)**

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1934 **656 (.44)**

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POISSON. — La **sécurité du mécanicien.** (4 700 mots & fig.)

1934 **621 .13 (09 (.44)**

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1934 **621 .392 & 621 .335**

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Spanische **Bahn-Elektrisierungen** mit 1 500 Volt Gleichstrom. (500 Wörter und Abb.)

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SCHARFENBERG (K.). — Völlig **selbsttätige Scharfenbergkupplung.** (500 Wörter und Abb.)

1934 **621 .43**
Elektrische Bahnen, November, S. 237.
WECHMANN. — Der **dieselelektrische Triebwagen,** seine Berechtigung. (600 Wörter.)

1934 **621 .43 (.43)**
Elektrische Bahnen, November, S. 239.
Die **elektrische Kraftübertragung** für die neuen dieselelektrischen Triebwagen der Deutschen Reichsbahn. (4 700 Wörter und Abb.)

1934 **621 .43**
Elektrische Bahnen, November, S. 248.
MÜLLER (A. E.). — Betrachtungen über den **dieselelektrischen Bahnbetrieb.** (6 100 Wörter und Abb.)

1934 **621 .43**
Elektrische Bahnen, November, S. 265.
KONRAD (H.). — Leistungssteuerungen für **dieselelektrische Fahrzeuge.** (2 000 Wörter.)

1934 **621 .43**
Elektrische Bahnen, November, S. 269.
Siemens-Ausrüstungen für **dieselelektrische Triebwagen.** (1 900 Wörter und Abb.)

Glasers Annalen. (Berlin.)

1934 **388 (.42)**
Glasers Annalen, Heft 9, 1. November, S. 65.
WERNEKKE. — **Vereinheitlichung** im Londoner Verkehr. (5 400 Wörter und Abb.)

1934 **62. (01 & 624. (0**
Glasers Annalen, Heft 10, 15. November, S. 73.
ROSTECK (W.). — Die Weiterentwicklung des **Röntgendurchstrahlungsverfahrens** bis zu den gegenwärtigen Groosdurch-Strahlungen bei den **Brückenuntersuchungen** der Deutchen Reichsbahn. (6 800 Wörter und Abb.)

Organ für die Fortschritte des Eisenbahnwesens. (Berlin.)

1934 **656 .212.5**
Organ für Fortschritte des Eisenbahnwesens, Heft 23, 1. Dezember, S. 421.
GOTTSCHALK. — Schädlichkeit der **Rangierstösse beim Stossverfahren.** (4 700 Wörter und Abb.)

1934 **625 .113 & 625 .144.2**
Organ für Fortschritte des Eisenbahnwesens, Heft 23, 1. Dezember, S. 427.
SCHRAMM (G.). — Beitrag zur **Gleisbogengestaltung** für hohe Fahrgeschwindigkeiten. (5 600 Wörter und Abb.)

1934 **625 .164**
Organ für Fortschritte des Eisenbahnwesens, Heft 23, 1. Dezember, S. 436.
MEID. — Über die **Einwirkung des Frostes auf die Strecke.** (600 Wörter.)

1934 **625 .172 (.47)**
Organ für Fortschritte des Eisenbahnwesens, Heft 23, 1. Dezember, S. 437.
SALLER. — **Unkrautvertilgung** auf Sowjetbahnen. (500 Wörter.)

Zeitschrift des Vereines Deutscher Ingenieure. (Berlin.)

1934 **62. (01 & 621 .392**
Zeitsch. des Ver. deutsch. Ing., Nr. 49, 8. Dezember, S. 1423.
GRAF (O.). — Dauerfestigkeit von **Schweissverbindungen.** (3 200 Wörter und Abb.)

1934 **625 .245**
Zeitsch. des Ver. deutsch. Ing., Nr. 49, 8. Dezember, S. 1435.
DROLL (A.). — Vierachsiger **Grossraum-Kippwagen.** (600 Wörter und Abb.)

Zeitung des Vereins Mitteleuropäischer Eisenbahnverwaltungen. (Berlin.)

1934 **385. (09.1 (.68)**
Zeitung des Vereins mitteleurop. Eisenbahnverw., Nr. 48, 29. November, S. 857.
MEYER (H. K.). — Reiseeindrücke von den **Eisenbahnen Südafrikas.** (4 600 Wörter.)

1934 **385 .517.6**
Zeitung des Vereins mitteleurop. Eisenbahnverw., Nr. 48, 29. November, S. 865.
NIEDERSTADT. — **Bahnärztefragen** von gestern und heute. (2 800 Wörter.)

1934 **656**
Zeitung des Vereins mitteleurop. Eisenbahnverw., Nr. 49, 6. Dezember, S. 877.
REMY. — Die Schienenbahn an der Schwelle eines **neuen Verkehrszeitalters.** (10 600 Wörter und Abb.)

1934 **621 .43 (.73)**
Zeitung des Vereins mitteleurop. Eisenbahnverw., Nr. 50, 13. Dezember, S. 901.
WITTE. — Ein neuer **Schnelltriebwagenzug** der Union Pacific-Eisenbahngesellschaft. (2 800 Wörter und Abb.)

In English.

Bulletin, American Railway Engineering Association. (Chicago, Ill.)

1934 **016 : 621 .33 & 016 : 621 .39**
ull. Amer. Ry. Engineering Asson, September, p. 3.
Report of Committee I. — Developments in applica-on of electricity to railway service. — Appendix A. — **pplications of electricity to railways. — Bibliography** : periodical articles appearing in a select list of perio-cals covering the period July 1933 to June 1934, repared by E. A. FREEMAN, cataloger, under the rection of the Librarian, Bureau of Railway Econo-ics Library, Washington, D. C.

1934 **621 .39 (.73)**
ull. Amer. Ry. Engineering Asson, September, p. 45.
Report of Committee VII. — **Standardization** of pparatus and materials. Revision of the manual as gards :
a) Specifications for friction tape.
b) Specifications for rubber insulating tape.
c) Specifications for wires and cables (other than transmission line and catenary construction).
700 words.)

1934 **621 .39 (.73)**
ull. Amer. Ry. Engineering Asson, September, p. 53.
Report of Committee VIII. — **Electric heating and elding** :
Application of electric heat for various purposes. lectric snow melters. Electric welding equipment as pplied to maintenance of way work. (4 800 words nd fig.)

1934 **621 .32 (.73) & 656 .215 (.73)**
ull. Amer. Ry. Engineering Asson, September, p. 71.
Report of Committee XIII. — **Illumination.**
1. Study of schedule of incandescent lamps.
2. Study of floodlighting in railroad yards.
000 words.)

1934 **625 .14 (01 (.52)**
ull. Amer. Ry. Engineering Asson, September, p. 87.
INOUYE (T.). — The calculation of **track stress** on e Japanese Government Railways. (4 000 words and g.)

Engineer. (London.)

1934 **621 .115**
ngineer, No. 4115, November 23, p. 502.
The surface condenser. No. XIV. (4 700 words, 1 table nd fig.)

1934 **621 .9 (064 (.42)**
ngineer, No. 4115, November 23, p. 505; No. 4116, No-vember 30, p. 533.
The Machine Tool and Engineering Exhibition at lympia, London. (23 000 words and fig.)

1934 **625 .14 & 656 .222.1**
Engineer, No. 4115, November 23, p. 512.
CARPMAEL (R.). — **Speeds of travel of the future.** (1 800 words.)

1934 **621 .132.6 (.42)**
Engineer, No. 4115, November 23, p. 522.
Great Western Ry. **heavy tank engines.** (150 words and fig.)

1934 **621 .392**
Engineer, No. 4115, November 23, p. 522.
An electrical process for welding aluminium. (400 words and fig.)

1934 **621 .43**
Engineer, No. 4116, November 30, p. 530.
Progress in **oil engine traction.** (3 800 words and fig.)

1934 **621 .9**
Engineer, No. 4116, November 30, p. 544.
HOLLOWAY (J.). — **Machine tools** from the works manager's point of view. (1 700 words.) (To be continued.)

1934 **621 .133.1**
Engineer, No. 4116, November 30, p. 548.
The work of the Fuel Research Board. (1 800 words.)

1934 **627 (.42) & 656 .213 (.42)**
Engineer, No. 4117, December 7, p. 558; No. 4118, December 14, p. 584.
The new **fish dock**, Grimsby. (7 300 words and fig.)

1934 **62. (01 & 669**
Engineer, No. 4117, December 7, p. 565.
Wear testing machine. (1 000 words and fig.)

1934 **625 .111 & 625 .162**
Engineer, No. 4117, December 7, p. 569.
Rail level crossings. (1 400 words.)

1934 **621 .9**
Engineer, No. 4117, December 7, p. 573; No. 4118, December 14, p. 586; No. 4119, December 21, p. 613.
HOLLOWAY (J.). — **Machine tools** from the works manager's point of view. (7 700 words.) (To be continued.)

1934 **621 .138 (.51) & 621 .9 (.51)**
Engineer, No. 4117, December 7, p. 576.
Locomotive jack for China. (300 words and fig.)

1934 **621 .43 (.42)**
Engineer, No. 4117, December 7, p. 576.
Shunting locomotive for L. M. S. Railway. (300 words and fig.)

1934 **656 .222.1 (.42)**
Engineer, No. 4118, December 14, p. 591.
High-speed railway runs. (2 000 words and 1 diagram.)

1934 621 .31 (.42) & 725 .4 (.42)
Engineer, No. 4118, December 14, p. 596; No. 4119, December 21, p. 614.
The new Fulham **power station** (7 900 words and fig.)

1934 621 .43
Engineer, No. 4119, December 21, p. 622.
Air swirl in oil engines. (2 000 words.)

1934 625 .154 (.42)
Engineer, No. 4119, December 21, p. 626.
Vacuum power locomotive turning gear. (700 words and fig.)

1934 621 .43
Engineer, No. 4119, December 21, p. 627.
ALCOCK (J. F.). — **Air swirl in oil engines.** (3 300 words and fig.)

Engineering. (London.)

1934 621 .9 (064 (.42)
Engineering, No. 3593, November 23, p. 549.
The Machine Tool and Engineering Exhibition, Olympia, London. — III. (11 000 words and fig.)

1934 621 .332 & 721 .3
Engineering, No. 3593, November 23, p. 561.
Sheet-steel telegraph and transmission poles. (900 words and fig.)

1934 621 .392
Engineering, No. 3593, November 23, p. 571.
The **welding of aluminium** by the electric arc (300 words.)

1934 669 .1
Engineering, No. 3593, November 23, p. 573.
HATFIELD (W. H.). — **Steel castings.** (1 800 words and fig.)

1934 669 .1
Engineering, No. 3593, November 23, p. 578.
SYKES (C.). — The physical properties of **iron-aluminium alloys.** (4 000 words, 7 tables and fig.)

1934 621 .133.1
Engineering, No. 3594, November 30, p. 595.
Fuel research. (2 400 words.)

1934 621 .43
Engineering, No. 3594, November 30, p. 599.
DAVIES (S. J.). — **The characteristics and performance of oil engines of Lanova design.** (2 200 words, 1 table and fig.) (To be continued.)

1934 621 .31 (.45) & 621 .43 (.45)
Engineering, No. 3595, December 7, p. 614.
Diesel-electric power station at Rome. (1 600 words and fig.)

1934 621 .9 (.43)
Engineering, No. 3595, December 7, p. 627.
Recent developments in German **woodworking machinery.** (4 000 words.)

1934 621 .138
Engineering, No. 3595, December 7, p. 629.
125-ton electric locomotive jacks. (400 words.)

1934 621 .93
Engineering, No. 3595, December 7, p. 634.
Petrol-driven continuous chain saw. (450 words and fig).

1934 65
Engineering, No. 3596, December 14, p. 641.
ELBOURNE (E. T.). — Workshop organisation and management. VI. — **Factory costing.** (5 300 words.)

1934 621 .5
Engineering, No. 3596, December 14, p. 648.
High-speed portable air compressor. (1 900 words and fig.)

1934 669 .1
Engineering, No. 3596, December 14, p. 656.
DESCH (C. H.). — **The crystallisation of alloys.** Lecture delivered on December 7, at the Royal Institution, London. (1 500 words.)

1934 621 .43
Engineering, No. 3596, December 14, p. 660.
DAVIES (S. J.). — The characteristics and performance of **oil engines** of Lanova design. (3 500 words and fig.)

1934 621 .31 (.437)
Engineering, No. 3597, December 21, p. 669.
The Trebovice **power station,** Silesia, Czechoslovakia (2 300 words and fig.)

1934 621 .335 (.42) & 621 .43 (.42)
Engineering, No. 3597, December 21, p. 672.
Armstrong Whitworth **Diesel-electric rail units** (2 400 words and fig.)

1934 621 .13, 625 .2 & 656 .222.
Engineering, No. 3597, December 21, p. 681.
Streamlined trains. (2 200 words.)

1934 621 .4
Engineering, No. 3597, December 21, p. 694.
ALCOCK (J. F.). — **Air swirl in oil engines.** — Paper read before the Institution of Mechanical Engineers, December 14, 1934 (Abridged.). (2 800 words and fig.)

Engineering News-Record. (New York.)

1934 621 .132.8 (.73) & 621 .43 (.73)
Engineering News-Record, No. 18, November 1, p. 56
Seven more **high-speed trains** to be built with P W A funds. (250 words.)

1934 **725 .4**
Engineering News-Record, No. 19, November 8, p. 585.
ALLEE (D. A.). — **New building form introduced by mercury-steam power plant.** (3 700 words and fig.)

1934 **621 .392 (.437) & 624 .62 (.437)**
Engineering News-Record, No. 19, November 8, p. 593.
FALTUS (F.). — **Welded steel arch** of 166-ft. span in Czechoslovakia. (300 words and fig.)

1934 **55, 625 .7 & 721 .1**
Engineering News-Record, No. 19, November 8, p. 594.
Advances in soil-testing methods. An interview with C. A. HOGENTOGLER and A. M. WINTERMYER, of the division of rests, U. S. Bureau of Public Roads. (3 700 words and fig.)

1934 **62. (01, 621 .392 & 669 .1**
Engineering News-Record, No. 19, November 8, p. 621.
Welded joints studied with new type polariscope. (600 words and fig.)

1934 **624 (.73) & 625 .13 (.73)**
Engineering News-Record, No. 21, November 22, p. 643.
Solid steel deck for a railroad bridge. (2 000 words and fig.)

1934 **62. (01 & 621**
Engineering News-Record, No. 21, November 22, p. 647.
TIMBY (E. K.). — **Photo-elasticity apparatus** embodies novel features. (900 words and fig.)

1934 **691 & 693**
Engineering News-Record, No. 21, November 22, p. 648.
BLANKS (R. F.). — Boulder Dam **cement and concrete studies.** (2 800 words and fig.)

1934 **691 & 693**
Engineering News-Record, No. 21, November 22, p. 651.
GONNERMAN (H. F.). — **Effect of cement composition on mortars and concretes.** (3 500 words and fig.)

1934 **625 .111 (.73)**
Engineering News-Record, No. 21, November 22, p. 661.
TORKELSON (M. W.). — **Road-railway grade-separation** program in Wisconsin. (2 100 words and fig.)

Institution of Civil Engineers. (London.)

1934 **624 .1**
Institut. of Civil Engineers, Selected Engineering Paper, No. 151.
ALLEN (J.) & DESHPANDE (D. L.). — **The design of piers for a bridge or sluice dam :** an investigation with the aid of model experiments. (6 000 words, 18 tables and fig.)

1934 **627 (.71)**
Institut. of Civil Engineers, Selected Engineering Paper, No. 152.
TORRANCE (A. A.). — **New harbour works,** Three Rivers, P. Q., Canada. (7 000 words and fig.)

1934 **627 (.81)**
Institut. of Civil Engineers, Selected Engineering Paper, No. 155.
CARRON (F. P. G.). — **The part of Parâ construction works.** (2 300 words and fig.)

1934 **624 .63 (.931)**
Institut. of Civil Engineers, Selected Engineering Paper, No. 157.
MORRISON (W. G.). — **The Carlton bridge,** Christchurch, New Zealand. (4 500 words, 2 tables and fig.)

1934 **38 (.941), 625 .1 (.941) & 627 (.941)**
Institut. of Civil Engineers, Selected Engineering Paper, No. 158.
STILEMAN (F. W. H.) & YOUNG (J. S.). — **Transport problems** in Western Australia, with special reference to **railway construction and harbour development.** (16 000 words, tables and fig.)

1934 **62. (01 (.42) & 624 .0 (.42)**
Institut. of Civil Engineers, Selected Engineering Paper, No. 161.
GOUGH (H. J.). — **Tests on cast-iron girders** removed from the British Museum. (7 000 words and fig.)

1934 **621 .392 (.42) & 624 .62 (.42)**
Institut. of Civil Engineers, Selected Engineering Paper, No. 162.
HAMMOND (B. C.). — The **strengthening** of a **cast-iron bridge by welded steel bars** encased in concrete; the Holt Fleet bridge, near Worcester. (5 000 words and fig.)

1934 **691 & 693**
Institut. of Civil Engineers, Selected Engineering Paper, No. 164.
LEA (F. C.). — **Fundamental assumptions in reinforced-concrete design.** (4 800 words and fig.)

1934 **624 .2**
Institut. of Civil Engineers, Selected Engineering Paper, No. 165.
TURNER (L.) & DAVIES (V. C.). — **Plain and reinforced concrete in torsion, with particular reference to reinforced-concrete beams.** (11 000 words, tables and fig.)

1934 **624 .3 (.66)**
Institut. of Civil Engineers, Selected Engineering Paper, No. 166.
THOMAS (W. E.). — The **construction of a bridge** over the river Benne at Makurdi, Nigeria. (9 200 words and fig.)

1934 **62. (01 & 669 .1**
Institut. of Civil Engineers, Selected Engineering Paper, No. 168.
SHAW (G. McIntosh). — **Methods of determining the thickness of steel plates and castings.** (2 700 words and fig.)

1934 **627 (.96)**
Institut. of Civil Engineers, Selected Engineering Paper, No. 171.
RAGG (A. A.). — **The port of Suva, Fiji;** its history and development. (11 000 words and fig.)

Journal, Institution of Engineers, Australia. (Sydney.)

1934 **621 .6 & 693**

Journal, Institut. of Engineers, Australia, Octob., p. 337.

THOMAS (G. O.). — The determination of the suitability of **bituminous coatings for underground pipes.** (7 000 words and fig.)

1934 **385. (091 (.945)**

Journal, Institut. of Engineers, Australia, Octob., p. 365.

Railway development in Victoria. (3 500 words and fig.)

Journal, Institute of Transport. (London.)

1934 **625 .1 & 656 .222.1**

Journal, Institute of Transport, December, p. 56.

CARPMAEL (R.). — **Speeds of travel of the future.** (11 000 words.)

1934 **38**

Journal, Institute of Transport, December, p. 69.

LAMB (D. R.). — **Practical and economic considerations in the study of transport.** (9 200 words.)

Mechanical Engineering. (New York.)

1934 **65**

Mechanical Engineering, December, p. 709.

Industrial management, 1934. — A report of progress in management prepared by the A. S. M. E., Management Division. (6 900 words and fig.)

1934 **536 (.73)**

Mechanical Engineering, December, p. 715.

GREENE (A. M.). — Early U. S. **steam tables.** (2 600 words.)

1934 **65**

Mechanical Engineering, December, p. 725.

SHEWHART (W. A.). — **Some aspects of quality control.** (7 500 words.)

1934 **385 .59 & 65**

Mechanical Engineering, December, p. 731.

PALMER (V. M.). — **The operation of a suggestion system.** (5 400 words.)

1934 **627 .82 (.73)**

Mechanical Engineering, December, p. 741.

KINZIE (P. A.). — **Hydraulic valves and gates** for Boulder Dam. (5 400 words and fig.)

Modern Transport. (London.)

1934 **656 .222.1 (.42)**

Modern Transport, No. 821, December 8, p. 3.

Speed potentialities of **steam locomotives.** 100 m.p.h. on L. N. E. R. test. (600 words, tables and fig.)

1934 **656 .253 (.42)**

Modern Transport, No. 821, December 8, p. 4.

Mechanical colour light signals on L. N. E. R. (1 100 words and fig.)

1934 **621 .43 (.42)**

Modern Transport, No. 821, December 8, p. 5.

Diesel locomotive for the Air Ministry for shunting service at Cranwell. (1 300 words and fig.)

1934 **621 .132.3 (.42) & 621 .132.6 (.42)**

Modern Transport, No. 821, December 8, p. 6.

Southern Ry. **tank locomotives.** « Baltic » type rebuilt. (750 words and fig.)

1934 **385 .4**

Modern Transport, No. 821, December 8, p. 9.

Can railway organisation be improved? Business methods in district administration. (2 200 words.)

1934 **385 .1**

Modern Transport, No. 822, December 15, p. 3.

LEMON (E. J. H.). — Future of railways. Steps towards **economy and efficiency.** (2 300 words.)

1934 **624 .52 (.54)**

Modern Transport, No. 822, December 15, p. 5.

New bridge over the Hooghly at Calcutta. — **Cantilever structure** to replace Howrah **floating bridge.** (1 000 words and fig.)

1934 **621 .132.3 (.42)**

Modern Transport, No. 822, December 15, p. 7.

New express passenger locomotive for L. N. E. R. « Earl Marshall » incorporates many features of « Cock o' the North ». (1 100 words and fig.)

Proceedings, American Society of Civil Engineers. (New York.)

1934 **624 .2**

Proceed., Amer. Soc. of Civil Engineers, November, p. 1251.

PARCEL (J. I.) & MURER (E. B.). — **Effect of secondary stresses upon ultimate strength**. (16 000 words and fig.)

1934 **62. (01 & 624 .2**

Proceed., Amer. Soc. of Civil Engineers, November, p. 1354.

LYSE (I.) & GODFREY (H. J.). — **Investigation of web buckling in steel beams.** (2 200 words and fig.)

1934 **721 .1**

Proceed., Amer. Soc. of Civil Engineers, November, p. 1360.

FRANZIUS (O). — Analysis of **sheet-pile bulkheads.** (1 200 words.)

1934 **624 .5**

Proceed., Amer. Soc. of Civil Engineers, November, p. 1368.

VOGT (F.), MOISSEIFF (L. S.), MITTCHELL (A.) & PARKIN (G. T.). — A generalized deflection theory for **suspension bridges.** (2 400 words.)

Proceedings, Institution of Railway Signal Engineers. (Reading).

1934 **656 .25 (.94)**
Proceed., Institut. of Ry. Signal, Engineers, Part I, Febr.-Sept., p. 14.
PRESCOTT (C. W.). — **Railway signalling** in Australia. (Paper and discussion.) (13 000 words, 2 tables and fig.)

1934 **656 .258**
Proceed., Institut. of Ry. Signal, Engineers, Part I, Febr.-Sept., p. 53.
Presidential address, 1934. — **History of the mechanical locking frame,** by R. S. GRIFFITHS. (4 800 words and fig.)

1934 **656 .254**
Proceed., Institut. of Ry. Signal, Engineers, Part I, Febr.-Sept., p. 65.
PETER (L. H.). — Some notes on **centralized traffic control.** (Paper and discussion.) (10 000 words and fig.)

1934 **656 .255**
Proceed., Institut. of Ry. Signal, Engineers, Part I, Febr.-Sept., p. 92.
ROBERTS (W. S.). — **Single line switching-out problems.** (Paper and discussion.) (10 000 words and fig.)

1934 **656 .25 (0 (.42)**
Proceed., Institut. of Ry. Signal, Engineers, Part I, Febr.-Sept., p. 119.
RICKETT (A. G.) & WAGENRIEDER (B.). — The **railway rule** book and its relation to **signalling.** (Paper and discussion.) (11 000 words and fig.)

1934 **016 : 656 .25**
Proceed., Institut. of Ry. Signal, Engineers, Part I, Febr.-Sept., p. 201.
Library catalogue.

1934 **656 .25 (06 (.42)**
Proceed., Institut. of Ry. Signal, Engineers, Part I, Febr.-Sept.
General index of **annual reports, meetings, dinners,** summer meetings, statement of accounts, papers, obituary notices.

Railway Age. (New York.)

1934 **625 .111 (.73)**
Railway Age, No. 21, November 24, p. 633.
« Boat-like » **construction** solves **water problem in underpass.** (3 200 words and fig.)

1934 **625 .24 (0 (.73)**
Railway Age, No. 21, November 24, p. 639.
HAWTHORNE (V. R.). — The **freight car** of the future (2 200 words.)

1934 **385 .3 (.73)**
Railway Age, No. 21, November 24, p. 647.
FLETCHER (R. V.). — **Need for order in transportation** (4 900 words.)

1934 **656 .1 (.73)**
Railway Age, No. 21, November 24, p. 653.
EASTMAN (J. B.). — **Sound truck regulation necessary** (2 000 words.)

Railway Engineer. (London.)

1934 **656 .222.1**
Railway Engineer, December, p. 371.
High speeds. (1 000 words.)

1934 **62. (01 & 621 .39**
Railway Engineer, December, p. 372.
Radiology in engineering. (900 words.)

1934 **624 .32 (.489)**
Railway Engineer, December, p. 375.
Bridging the Little Belt (Denmark). (1 600 words and fig.)

1934 **625 .143.4 (.43)**
Railway Engineer, December, p. 380.
A flexible welded rail joint. (1 000 words and fig.)

1934 **621 .132.8 (.73)**
Railway Engineer, December, p. 381.
POULTNEY (E. C.). — Recent American locomotive practice. — Part III : **Articulated locomotives.** (2 400 words and fig.)

1934 **621 .135.4**
Railway Engineer, December, p. 384.
PORTER (the late S. R. M.). — The mechanics of a locomotive on curved track. — V. — Part II continued: **Nature of slip between tyre and rail.** (2 200 words and fig.)

1934 **621 .131.3**
Railway Engineer, December, p. 387.
Practical locomotive tests (1). — **Loads.** (1 000 words and fig.)

1934 **621 .392 & 625 .143.3**
Railway Engineer, December, p. 388.
Recent developments in the **welding of rails.** (3 000 words and fig.)

1934 **621 .133.8 (.68)**
Railway Engineer, December, p. 392.
Boiler standardisation in South Africa. (1 200 words and fig.)

1934 **625 .14 (01**
Railway Engineer, December, p. 396.
Measurement of lateral thrust on rails. (1 500 words and fig.)

Railway Gazette. (London.)

1934 **656 .223.1 (.42)**
Railway Gazette, No. 21, November 23, p. 848.
Manipulation of passenger carrying stock on the L. M. S. R. (2 200 words and fig.)

1934 **625 .143 (.68)**
Railway Gazette, No. 21, November 23, p. 854.
South African Railway **permanent way.** (800 words and fig.)

1934 **625 .4 (.43) & 656 .211.5 (.43)**
Railway Gazette, No. 22, November 30, p. 896.
Escalators on the Berlin Stadtbahn. (600 words and fig.)

1934 **385. (09.1 (.71)**
Railway Gazette, No. 22, November 30, p. 897.
Montreal and its railways. (1 800 words and fig.)

1934 **625 .212 (.43)**
Railway Gazette, No. 22, November 30, p. 901.
Light wheel sets. (300 words and fig.)

1934 **621 .132.6 (.54)**
Railway Gazette, No. 22, November 30, p. 902.
New metre-gauge tank locomotives for India. (400 words and fig.)

1934 **621 .132.7 (.42) & 621 .43 (.42)**
Diesel Ry. Traction, p. 914, Supplt. to the Ry. Gazette, November 30.
Another **six-coupled shunter** for the L. M. S. Ry. (950 words and fig.)

1934 **621 .43 (.44)**
Diesel Ry. Traction, p. 916, Supplt. to the Ry. Gazette, November 30.
Small **Diesel-electric railcar** in France. (200 words and fig.)

1934 **621 .43 (.42)**
Diesel Ry. Traction, p. 918, Supplt. to the Ry. Gazette, November 30.
L. M. S. Ry. **250 b.h.p. Diesel electric shunting locomotive.** (1 400 words and fig.)

1934 **621 .43 (.41)**
Diesel Ry. Traction, p. 920, Supplt. to the Ry. Gazette, November 30.
New **broad-gauge Diesel railcar** in Ireland. (1 200 words and fig.)

1934 **621 .43 (.68) & 625 .616 (.68)**
Diesel Ry. Traction, p. 922, Supplt. to the Ry. Gazette, November 30.
British **Diesel locomotive** for South Africa. (300 words and fig.)

1934 **621 .335 & 621 .43**
Diesel Ry. Traction, p. 923, Supplt. to the Ry. Gazette, November 30.
The three-power shunting locomotive. (900 words and 1 table.)

1934 **621 .43 (.438)**
Diesel Ry. Traction, p. 925, Supplt. to the Ry. Gazette, November 30.
The adoption of **Diesel traction** in Poland. (900 words.)

1934 **621 .43 (.481)**
Diesel Ry. Traction, p. 927, Supplt. to the Ry. Gazette, November 30.
The farthest North in Diesels. — **Norwegian railcar for heavily-graded line** has high power per unit of weight. (500 words and fig.)

1934 **621 .43 (.42)**
Diesel Ry. Traction, p. 928, Supplt. to the Ry. Gazette, November 30.
Seventh L. M. S. Ry. **Diesel shunter.** (500 words and fig.)

1934 **385 .4 (.66)**
Railway Gazette, Special issue, November 28, p. 9.
Divisional or departmental organisation for overseas railways, by Mr. G. V. O. BULKELEY, General Manager, Nigerian Government Railways. (1 600 words.)

1934 **621 .43 (.82)**
Railway Gazette, Special issue, November 28, p. 10.
Diesel traction in Argentina. (800 words.)

1934 **385. (01 & 656 .237**
Railway Gazette, Special issue, November 28, p. 11.
FORBES (P. H.). — **The aims and achievement of colonial railway accounting departments.** (1 200 words.)

1934 **385 .1 (.82)**
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The Argentine railway situation. (**Exchange restrictions and road competition.**) (1 600 words.)

1934 **385 .1 (.82)**
Railway Gazette, Special issue, November 28, p. 13.
Buenos Ayres and Pacific Railway. (800 words.)

1934 **385 .1 (.82)**
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Buenos Ayres Western Railway. (**Railcar services and maintenance organisation.**) (1 400 words.)

1934 **385 .1 (.82)**
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Transport of milk in Argentina. (Thermos-tank wagons.) (1 000 words.)

1934 **385 .1 (.82)**
Railway Gazette, Special issue, November 28, p. 16.
Cordoba Central Railway. (**Improvements in the locomotive and permanent way departments.**) (1 200 words.)

1934 **385. (091 (.∞)**
Railway Gazette, Special issue, November 28, p. 17.
Typical scenes on overseas railways. (Fig.)

1934 **385 .1 (.81) & 656 .1 (.81)**
Railway Gazette, Special issue, November 28, p. 49.
The Leopoldina Railway. (**Road competition in passenger and freight traffic and difficulties of exchange.**) (2 600 words.)

1934 **385 .1 (.83)**
Railway Gazette, Special issue, November 28, p. 51.
The Taltal Railway. (**Conveyance of nitrate in bulk at favourable rates.**) (800 words.)

1934 **385 .1 (.54)**
Railway Gazette, Special issue, November 28, p. 52.
Bengal and North Western Railway. (**Description of the line and traffic.**) (1 500 words.)

1934 **381 .1 (.54)**
Railway Gazette, Special issue, November 28, p. 53.
Rohilkund and Kumaon Railway. (**Unusual problems: Persons travelling without tickets and attempts to cut embankments to provide an outlet for flood water.**) (1 000 words.)

1934 **385 .1 (.54) & 656 .1 (.54)**
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His Exalted Highness the Nizam's State Railway. (**Description of the system and of the road transport activities of this administration.**) (900 words and 1 table.)

1934 **385 .1 (.54)**
Railway Gazette, Special issue, November 28, p. 55.
North Western (State) Railway, India. (An analysis of the measures taken to combat the effects of the world crisis on one of the Indian State systems.) (1 300 words.)

1934 **385 .1 (.54)**
Railway Gazette, Special issue, November 28, p. 56.
Assam Bengal Railway Co. Ltd. (600 words and 1 table.)

1934 **385 (.51)**
Railway Gazette, Special issue, November 28, p. 57.
Recent railway development in China. (800 words.)

1934 **621 .138.5 (.91)**
Railway Gazette, Special issue, November 28, p. 57.
Accelerating locomotive repairs, F. M. S. Rys. (400 words.)

1934 **385 .1 (.68)**
Railway Gazette, Special issue, November 28, p. 58.
South African Railways and Harbours. A summary of the findings of the Granet Commission regarding South African Railways **finance and organisation.** (1 900 words.)

1934 **385 .1 (.66)**
Railway Gazette, Special issue, November 28, p. 59.
Nigerian Government Railway. **Reduced fares resulting in an increase of over two million passengers are among the points brought out in the General Manager's report for the past financial year.** (1 900 words.)

1934 **385 .1 (.64)**
Railway Gazette, Special issue, November 28, p. 61.
Kenya and Uganda Rys. and Harbours. (1 200 words.)

1934 **385 .1 (.67)**
Railway Gazette, Special issue, November 28, p. 62.
Gold Coast Government Railway. (1 600 words.)

1934 **385 .1 (.62)**
Railway Gazette, Special issue, November 28, p. 63.
Egyptian State Railways, Telegraphs and Telephones. — **Encouragement of traffic; measures of economy; new workshops; railcars.** (800 words.)

1934 **385 .1 (.62)**
Railway Gazette, Special issue, November 28, p. 64.
The Sudan Railways. (2 100 words.)

1934 **385 .1 (.931)**
Railway Gazette, Special issue, November 28, p. 66.
New Zealand Government Railways. — **Improvements in the comfort of passenger rolling stock and the speed of goods services.** (1 400 words.)

1934 **385 .1 (.941) & 656 .1 (.941)**
Railway Gazette, Special issue, November 28, p. 67.
Western Australian Government Railways. — **A summary of the railway position with regard to road transport.** (1 000 words.)

1934 **385 .1 (.943) & 656 .1 (.943)**
Railway Gazette, Special issue, November 28, p. 68.
Rail motor operation in Queensland. — Provision of **rail motor services.** (1 400 words.)

1934 **385 .1 (.945)**
Railway Gazette, Special issue, November 28, p. 69.
Victorian Government Railways. A survey of recent **legislation and technical developments.** (2 100 words.)

1934 **385 .1 (.71)**
Railway Gazette, Special issue, November 28, p. 71.
Canadian National Railways. (1 100 words.)

1934 **385 (.56)**
Railway Gazette, Special issue, November 28, p. 72.
Palestine Railways. (1 000 words.)

1934 **621 .43 (.73) & 656 (.73)**
Railway Gazette, No. 23, December 7, p. 939.
ARTHURTON (A. W.). — Impressions of overseas transport. III. — American experiments in **high-speed railway transport** have aroused intense public interest in the streamlined units here described. (1 000 words.)

1934 **625 .215 (.42)**
Railway Gazette, No. 23, December 7, p. 940.
Sheffield **double-frame welded bogie.** (900 words.)

1934 **625 .232 (.68)**
Railway Gazette, No. 23, December 7, p. 941.
New passenger rolling stock for South Africa. (500 words and fig.)

1934 **621 .132.3 (.42)**
Railway Gazette, No. 23, December 7, p. 945.
An interesting locomotive conversion. — **Southern Railway Baltic tank engines rebuilt as 4-6-o type engines with tenders.** (500 words and fig.)

1934 **656 .222.1 (.42)**
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A record L. N. E. R. run. (1 800 words.)

1934 **656 (.73)**
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ARTHURTON (A. W.). — Impressions of overseas transport. — **IV. Modernity and the out-of-dateness respectively help and hinder the gigantic traffic problem of New York.** The Grand Central terminal described. (750 words.)

1934 **656 .253 (.42)**
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Mechanical colour-lights for the N. E. Area, L. N. E. R. (1 000 words and fig.)

1934 **625 .232 (.68)**
Railway Gazette, No. 24, December 14, p. 977.
Commissioner's inspection car, South Australian Rys. (900 words and fig.)

1934 **656 .213 (.42)**
Railway Gazette, No. 24, December 14, p. 985.
The new maritime station at Cherbourg. (600 words and fig.)

1934 **625 .213**
Railway Gazette, No. 24, December 14, p. 986.
The evolution of railway vehicle suspension. (1 700 words.)

1934 **656 .222.1**
Railway Gazette, No. 24, December 14, p. 987.
The cost of speed. (1 300 words.)

1934 **621 .33 (.∞)**
Electric Ry. Traction, p. 996, Supplt. to the Ry. Gazette, December 14.
Railway electrification in 1934. (1 700 words and fig.)

1934 **621 .331 (.42)**
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Control equipment for electric systems. (700 words and fig.)

1934 **621 .33**
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Electricity Supply Bill and the Railways. (2 000 words.)

1934 **621 .33 (.42) & 625 .4 (.42)**
Electric Ry. Traction, p. 1003, Supplt. to the Ry. Gazette, December 14.
Glasgow subway electrification. (1 900 words and fig.)

1934 **62. (01 & 621 .333**
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SYLVESTER (C.). — **Testing for earths, open and short circuits in electric motors.** (1 700 words and fig.)

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1934 **656 .222.1 (.44)**
Railway Magazine, December, p. 391.
Modern locomotive work in France. V. — P. L. M. Railway. (3 500 words, 5 tables and fig.)

1934 **656 .222.1 (.42)**
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ALLEN (C. J.). — **British locomotive practice and performance.** (4 400 words and tables.)

1934 **625 .232 (.42) & 656 .224 (.42)**
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LEE (Ch. E.). — Familiar features of operation. — I. — **The travelling Post Office.** (1 900 words and fig.)

1934 **656 (.42)**
Railway Magazine, December, p. 439.
SMITH (D. M.). — **The development of railway air services.** (1 000 words and fig.)

Railway Signaling. (London.)

1934 **656 .254 (.73) & 656 .255 (.73)**
Railway Signaling, November, p. 539.
Junction controlled remotely on the Lehigh Valley. — New power switches and signals controlled by c.t.c. type of equipment replaces mechanical interlocking. (1 600 words and fig.)

1934 **656 .254 (.42 + .44)**
Railway Signaling, November, p. 541.
Centralized traffic control in Europe. (2 000 words and fig.)

1934 **656 .258 (.73)**
Railway Signaling, November, p. 544.
Interlocking three miles long on the Chesapeake and Ohio. (2 000 words and fig.)

1934 **625 .151 (.73) & 656 .254 (.73)**
Railway Signaling, November, p. 547.
Spring switch on the Great Northern. (1 100 words and fig.)

1934 **656 .254 (.73)**
Railway Signaling, November, p. 549.
Remote control on the Missouri-Kansas-Texas. (3 000 words and fig.)

1934 **656 .254 (.73)**
Railway Signaling, November, p. 553.
Remote control on the Northern Pacific. (1 300 words and fig.)

1934 **656 .256 (.73)**
Railway Signaling, November, p. 555.
An automatic ground detector. (800 words and fig.)

The Locomotive. (London.)

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The Locomotive, December 15, p. 370.
Great Northern Railway (Ireland), **pneumatic-tyred petrol railbus.** (1 600 words and fig.)

1934 **625 .232 (.66) & 625 .253 (.66)**
The Locomotive, December 15, p. 372.
Steel passenger cars, Nigerian Railways. (1 300 words and fig.)

1934 **621 .133.7 (.42)**
The Locomotive, December 15, p. 381.
The « Metcalfe » vacuum brake ejector. (2 100 words and fig.)

1934 **621 .131.2**
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PHILLIPSON (E. A.). — **Steam locomotive design : Data and formulæ. — The Vacuum automatic brake.** (1 000 words and fig.)

1934 **621 .134 & 669 .1**
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WILLIAMS (C. E.). — **Special steels for locomotive coupling and connecting rods.** (1 200 words and fig.)

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1934 **621 .338 (.73)**
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Light-weight street car developed in Detroit. (2 200 words and fig.)

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1934 **669 .1**
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ORIAND (P. J.). — **Ensayos sobre la fragilidad de los aceros dulces al carbono.** (4 300 palabras, 8 tablas & fig.)

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MONREAL (M.) & CASTILLO (M.). — **La crisis ferroviaria y sus posibles remedios.** (2 500 palabras & fig.) (Continuará.)

1934 **656 .254**
Caminos de hierro, noviembre, p. 288.
MONREAL (M.). — **El problema de los pasos a nivel.** (1 000 palabras.)

Ferrocarriles y Tranvias. (Madrid.)

1934 **656 .256.3**
Ferrocarriles y Tranvias, noviembre, p. 390.
LUCINI (M.). — **Señalización en lineas electrificadas.** (5 300 palabras & fig.)

1934 **385 .1 (.73)**
Ferrocarriles y Tranvias, noviembre, p. 408.
La situación crítica de los ferrocarriles de los Estados Unidos. (2 400 palabras.)

Ingenieria y Construcción. (Madrid.)

1934 **656 .254**
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ROSELLO GONZALEZ (M.). — **Sistema electromecánico para impedir los accidentes en los pasos a nivel.** (2 400 palabras & fig.)

1934 **656 (.460)**
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Informe de las Compañias sobre el proyecto de ley de **ordenación ferroviaria.** (7 200 palabras.)

1934 **621 .33 (.489)**
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RAMOS Y CHAPULI (J. L.). — **Electrificación de los ferrocarriles daneses.** (1 700 palabras & fig.)

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VELO (B.). — **Hormigón armado.** (1 000 palabras & fig.)

In Italian.

L'Ingegnere. (Roma.)

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BRANCOLI-BUSDRAGHI (R.). — Le Metropolitane in tempo di crisi : Considerazioni sul bilancio di alcune **linee Metropolitane.** (5 700 parole, 4 tavole & fig.)

1934 **625 .1 (.45)**
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1934 **62. (01**

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SCHOENMAKER (P.). — **De kerfslagproef.** (5 400 woorden & 5 tabellen.)

Spoor- en Tramwegen. (Utrecht.)

1934 **621 .135.3**

Spoor en Tramwegen, N° 25, 4 December, p. 643; N° 26, 18 December, p. 670.

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1934 **625 .163 (.492)**

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LEOPOLD (G.). — **De stationsversieringen der Nederlandsche Spoorwegen in 1934.** (1 600 woorden & fig.)

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(= 91.885)

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1934 **621 .33 (.438) = 91 .885**

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[016. 385. (02]

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1934 385 .12 (.494)

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1934 621. (02

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(1) The numbers placed over the title of each book are those of the decimal classification proposed by the Railway Congress conjointly with the Office Bibiagraphique International, of Brussels. (See « Bibliographical Decimal Classification as applied to Railway Science », by L. Weissenbruch, in the number for November 1897, of the *Bulletin of the International Railway Congress*, p. 1509).

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1934 385 .113 (.45)
Bull. des transp. intern. par ch. de fer, décembre, p. 593.
Résultats de l'exploitation des chemins de fer de l'Etat italien pour l'exercice 1932-33. (2 000 mots.)

1935 313 .385 (.497.2)
Bull. des transp. intern. par ch. de fer, janvier, p. 42.
Les **chemins de fer de l'Etat bulgare** en 1932-33. (1 800 mots.)

1935 385 .62
Bull. des transp. intern. par ch. de fer, janvier, p. 53.
Convention internationale concernant le transport des voyageurs et des bagages par chemins de fer (C.I.V.) du 23 novembre 1933. (14 000 mots.)

Chronique des transports. (Paris.)

1934 656
Chronique des transports, n° 24, 25 décembre, p. 2.
Les **transports automobiles** et la protection du public. (3 500 mots.)

1934 656
Chronique des transports, n° 24, 25 décembre, p. 6.
Transports automobiles et prix de revient. (3 600 mots.)

1935 385 .1 (.44)
Chronique des transports, n° 2, 25 janvier, p. 2.
Les **chemins de fer** et le budget. (2 000 mots.)

Génie civil. (Paris.)

1934 625 .143.3
Génie civil, n° 2732, 22 décembre, p. 572.
MERKLEN (J.) et VALLOT (E.). — **Ruptures et avaries accidentelles des rails.** Exposé et discussion des objections faites aux conclusions d'une étude précédente. (3 000 mots et fig.)

1934 624 .63 (.44)
Génie civil, n° 2733, 29 décembre, p. 602.
CAYLA (M.). — Les **ponts en béton armé** de Laifour et d'Anchamps, sur la Meuse. (2 200 mots et fig.)

1934 656 .222.1 (.3)
Génie civil, n° 2733, 29 décembre, p. 609.
PONDEVEAUX (L.). — Les plus **grandes relations** ferroviaires dans le monde entier, en 1934. (1 600 mots.)

1935 621 .43
Génie civil, n° 2734, 5 janvier, p. 12; n° 2735, 12 janvier, p. 33.
GAUTIER. — **La suralimentation des moteurs Diesel.** (6 300 mots et fig.)

1935 **621 .132.8**
Génie civil, nº 2735, 12 janvier, p. 20.
Locomotive à vapeur, type C + C, pour voie métrique, système Sentinel, à commande individuelle des essieux. (700 mots et fig.)

1935 **621 .132.3 (.42)**
Génie civil, nº 2736, 19 janvier, p. 63.
MARTIN (H.). — **La locomotive type « Mikado »** du London & North Eastern Railway. (3 000 mots et fig.)

1935 **669 .1**
Génie civil, nº 2737, 26 janvier, p. 84.
La **fabrication directe du fer** par le procédé Krupp. (3 400 mots et fig.)

1935 **621 .33**
Génie civil, nº 2737, 26 janvier, p. 87.
PARODI (H.). — **L'électricité appliquée à la traction.** (3 000 mots.)

1935 **388**
Génie civil, nº 2738, 2 février, p. 114.
MARIAGE. — Les **transports en commun** et leur évolution actuelle. (2 300 mots.)

Les Chemins de fer et les Tramways. (Paris.)

1935 **625 .4**
Les Chemins de fer et les Tramways, janvier, p. 2.
SPIESS (E.). — **Métropolitains.** (10 000 mots et fig.)

1935 **621 .43**
Les Chemins de fer et les Tramways, janvier, p. 9.
Locomotives Diesel à transmission directe. (2 500 mots et fig.)

1935 **621 .43**
Les Chemins de fer et les Tramways, janvier, p. 10.
Transmissions électriques pour moteurs Diesel. (5 000 mots et fig.)

1935 **625 .173**
Les Chemins de fer et les Tramways, janvier, p. 15.
VIÉ (G.). — Les engins mécaniques et les **procédés modernes de pose et d'entretien des voies ferrées.** (7 200 mots et fig.)

L'Ossature métallique. (Bruxelles.)

1935 **691 & 693**
L'Ossature métallique, janvier, p. 24.
PAHLAVOUNI (E.). — L'étude de la **corrosion** entreprise en Angleterre par l'Institut du fer et de l'acier. (6 400 mots et fig.)

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1935 **656 .253**
Revue générale des chemins de fer, janvier, p. 3.
RECHER. — Les **feux colorés** dans la signalisation des chemins de fer. (3 000 mots et fig.)

1935 **625 .215 (.44)**
Revue générale des chemins de fer, janvier, p. 14.
VALLANCIEN (J.). — **Le bogie Y^5 en acier moulé** pour essieux de 20 tonnes et les bogies pour wagons à marchandises. (5 400 mots, 2 tableaux et fig.)

1935 **385 (.494) & 656 (.494)**
Revue générale des chemins de fer, janvier, p. 39.
Les **Chemins de fer fédéraux suisses** pendant l'exercice 1933. (5 700 mots.)

1935 **625 .251**
Revue générale des chemins de fer, janvier, p. 55.
Recherche des **conditions d'adhérence entre roue et rail** au cours d'un freinage. (1 500 mots.)

Revue universelle des Mines. (Liége.)

1935 **621 .9**
Revue universelle des mines, nº 1, 1er janvier, p. 3.
WASSENHOVE (A. van) et BODART (E.). — La graduation des **vitesses de rotation des machines-outils.** (4 300 mots et fig.)

In German.

Die Lokomotive. (Wien.)

1934 **621 .43**
Die Lokomotive, Dezember, S. 217.
Schnelltriebwagen mit diesel-mechanischem Antrieb. (3 000 Wörter & Abb.)

1934 **621 .133.1 & 621 .33**
Die Lokomotive, Dezember, S. 229.
Energiewirtschaft der Eisenbahnen. (2 900 Wörter.)

1935 **621 .132.8 (.438)**
Die Lokomotive, Jänner, S. 1.
TATARA (F.). — **1-E1-Gebirgstenderlokomotive** der Polnischen Staatsbahnen für Schnell- und Personenzüge. (2 400 Wörter & Abb.)

Elektrische Bahnen. (Berlin.)

1934 **621 .33 (.481)**
Elektrische Bahnen, Dezember, S. 274.
SCHREINER (H.). — **Elektrische Zugförderung** in Norwegen. (500 Wörter & Abb.)

1934 **621 .33 (.439)**
Elektrische Bahnen, Dezember, S. 279.
von VEREBELIJ (L.). — Die Aufnahme des **elektrischen Betriebes** auf der ganzen Linie von Budapest bis Hegyeshalom. (1 000 Wörter & Abb.)

Glasers Annalen. (Berlin.)

1934 **385 .1 (.43) & 656 .237 (.43)**
lasers Annalen, Heft 11, 1. Dezember, S. 85.
GOEDECKE (D.). — Die **Wirtschaftsführung** der
eichsbahn. (2 800 Wörter & Abb.)

1934 **621 .133.2 & 621 .133.3**
lasers Annalen, Heft 11, 1. Dezember, S. 89.
CRAMER. — **Einschweissen von Stehbolzen** in die
ipfernen Feuerbuchswände des Lokomotiv-Kessels.
.500 Wörter & Abb.)

1934 **621 .131.2 & 621 .135.4**
lasers Annalen, Heft 11, 1. Dezember, S. 90.
OTTERSBACH. — Die Weiterentwicklung des
ptisch-mechanischen Vermessens der Lokomotiven, ins-
esondere das Vermessen der Drehgestelle und das
earbeiten der zugehörigen Achslagerführungen. (4 500
Törter & Abb.)

1934 **625 .212**
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KREISSIG (E.). — Das **Reibungsgleichgewicht** starr
elagerter Radsätse beim Lauf in der Geraden. (1 400
Törter & Abb.)

1934 **625 .245**
lasers Annalen, Heft 11, 1. Dezember, S. 100.
DROLL (A.). — Vierachsiger normalspuriger **Gross-
aumkippwagen.** (1 500 Wörter & Abb.)

1934 **621 .131.1**
lasers Annalen, Heft 12, 15. Dezember, S. 105.
LUBIMOFF (W.). — **Reibungsgrenze der Zugkraft**
on Lokomotiven. (4 200 Wörter & Abb.)

1934 **621 .133.3**
lasers Annalen, Heft 12, 15. Dezember, S. 109.
WEESE. — **Heizrohrbefestigung** neuer Bauart. (800
Törter & Abb.)

1935 **621 .133.7**
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JULIUSBURGER (P.). — Über Wirtschaftlichkeits-
nessungen an **Speisewasser-Vorwärmer-Anlagen** für
okomotiven. (3 500 Wörter & Abb.)

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1934 **621 .135.4 & 625 .215**
rgan für die Fortschritte des Eisenbahnwesens,
Heft 24, 15. Dezember, S. 439.
HEUMANN. — **Die freien Lenkachsen im Gleisbogen**
ei Zweipunktberührung. (9 000 Wörter & Abb.)

1934 **621 .135. (01 & 621 .135.3**
rgan für die Fortschritte des Eisenbahnwesens,
Heft 24, 15. Dezember, S. 452.
BREZINA (R.). — Zur Beurteilung der **Standsicher-
eit von Lokomotiven.** (1 700 Wörter & Abb.)

1935 **621 .33 (.436)**
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Heft 1, 1. Januar, S. 1.
LUITHLEN (H.). — Ein Überblick über die **Elektri-
sierung der Österreichischen Bundesbahnen.** (5 000 Wör-
ter & Abb.)

1935 **621 .335 (.45)**
Organ für die Fortschritte des Eisenbahnwesens,
Heft 1, 1. Januar, S. 19.
WERNEKKE. — **Elektrische Einheits-Gleichstrom-
lokomotiven** der Italienischen Staatsbahnen. (2 100
Wörter & Abb.)

1935 **621 .134.1**
Organ für die Fortschritte des Eisenbahnwesens,
Heft 2, 15. Januar, S. 23.
MARTIN (K.). — Neuartige **Lokomotivstangenlager-
bearbeitung.** (3 000 Wörter & Abb.)

1935 **621 .134.5, 621 .135.2 & 625 .214**
Organ für die Fortschritte des Eisenbahnwesens,
Heft 2, 15. Januar, S. 27.
SCHNEIDER (L.). — Die **Gleitlagerreibung** bei
Fettschmierung. (2 200 Wörter & Abb.)

1935 **621 .138.5**
Organ für die Fortschritte des Eisenbahnwesens,
Heft 2, 15. Januar, S. 29.
COENEN (M.). — Bearbeitung von **Lokomotiv-Zube-
hörteilen.** (1 000 Wörter & Abb.)

1935 **621 .133.2**
Organ für die Fortschritte des Eisenbahnwesens, Heft 2,
15. Januar, S. 31.
SILBEREISEN. — **Einschweissen von Stehbolzen** in
kupferne Lokomotiv-Feuerbuchsen. (400 Wörter.)

1935 **669**
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15. Januar, S. 32.
REIDEMEISTER (F.). — **Leichtmetalle** und ihre
Verwendung **im Eisenbahnwesen.** (5 600 Wörter.)

1935 **625 .14 (01**
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1. Februar, S. 41.
ADLER (A.). — Über **Statik und Dynamik (Schwin-
gungen) des Oberbaues.** (6 500 Wörter, 1 Tabelle &
Abb.)

1935 **625 .142.1 (.47)**
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1. Februar, S. 52.
SALLER (H.). — **Neuer Oberbau** der Sowjetbahnen.
(2 100 Wörter & Abb.)

Zeitschrift des Vereines Deutscher Ingenieure. (Berlin.)

1934 **62. (01 & 669 .1**

Zeitsch. des Ver. deutsch. Ing., Nr. 51, 22. Dezember, S. 1469.

SCHWINNING (W.), KNOCH (M.) & UHLEMANN (K.). — Wechselfestigkeit und Kerbempfindlichkeit der **Stähle bei hohen Temperaturen.** (3 900 Wörter, 2 Tafeln & Abb.)

1935 **624 .62 (.485)**

Zeitsch. des Ver. deutsch. Ing., Nr. 1, 5. Januar, S. 11.

SEIDEL (H.). — Feste **Strassenbrücke** über den Mälarsee. (700 Wörter & Abb.)

1935 **62. (01**

Zeitsch. des Ver. deutsch. Ing., Nr. 1, 12. Januar, S. 35.

SCHWINNING (W.). — Die **Festigkeitseigenschaften der Werkstoffe** bei tiefen Temperaturen. (2 400 Wörter, 2 Tafeln & Abb.)

1935 **621 .392**

Zeitsch. des Ver. deutsch. Ing., Nr. 1, 12. Januar, S. 41.

SCHOTTKY (H.). — Das **Schweissen** der warmfesten und hitzebeständigen Stahllegierungen. (3 300 Wörter & Abb.)

1935 **62. (01**

Zeitsch. des Ver. deutsch. Ing., Nr. 1, 12. Januar, S. 47.

UDE (H.). — Steigerung der **Dauerhaltbarkeit der Konstruktionen.** (4 800 Wörter, 3 Tafeln & Abb.)

1935 **621 .135.2 & 625 .214**

Zeitsch. des Ver. deutsch. Ing., Nr. 4, 26. Januar, S. 98.

WITTE (Fr.). — **Blei-Lagermetalle.** Der heutige Stand der Technik und die Erkenntnisse in der Verwendung. (2 400 Wörter & Abb.)

Zeitschrift für das gesamte Eisenbahn-Sicherungswesen. (Berlin.)

1934 **656 .256**

Zeitschrift für das gesamte Eisenbahn-Sicherungswesen, Nr. 15, 20. November, S. 181; Nr. 16, 10. Dezember, S. 198.

GRADL. — **Gleichstrom Bahnhofsblockung.** (3 200 Wörter & Abb.) (Schluss folgt.)

1934 **656 .212.5 & 656 .254**

Zeitschrift für das gesamte Eisenbahn-Sicherungswesen, Nr. 16, 10. Dezember, S. 190.

OESER (W.). — Neuartige **Befehlsanlagen für den Rangierbetrieb.** (700 Wörter & Abb.)

1935 **625 .162 (.43)**

Zeitschrift für das gesamte Eisenbahn-Sicherungswesen, Nr. 1, 10. Januar, S. 3.

BUDDENBERG. — Die **Reichsbahnschranke.** (2 200 Wörter & Abb.) (Fortsetzung folgt.)

1935 **656 .254 (.43)**

Zeitschrift für das gesamte Eisenbahn-Sicherungswesen, Nr. 1, 10. Januar, S. 7.

HOFMANN (F.). — Versuche mit der **optischen Zugbeeinflussung** für punktweise Geschwindigkeitsbegrenzung bei Saalfeld. (1 500 Wörter & Abb.) (Schluss folgt.)

Zeitung des Vereins mitteleuropäischer Eisenbahnverwaltungen. (Berlin.)

1934 **656 .235 (.43)**

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BALLOF. — Wirtschaftsbelebung und **Eisenbahngüterverkehr** im Jahre 1933. (4 600 Wörter, 4 Tafeln & Abb.)

1935 **385 (.4)**

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WULFF. — **Rückblich auf das Jahr 1934.** (41 500 Wörter.)

1935 **385. (09.1 (.47) & 625 .1 (.47)**

Zeitung des Vereins mitteleuropäischer Eisenbahnverw., Nr. 2, 10. Januar, S. 55.

LUBIMOFF (W.). — **Erweiterung des Eisenbahnnetzes** in der Ud. S. S. R. (1 900 Wörter & Abb.)

In English.

Engineer. (London.)

1934 **621 .7 & 669 .1**

Engineer, No. 4120, December 28, p. 634.

The steel ball : Early methods of manufacture. (5 000 words & fig.)

1934 **621 .9**

Engineer, No. 4120, December 28, p. 638.

MERRITT (H. E.). — **Measuring the uniformity of machine motions.** (1 800 words & fig.)

1934 **669 .1**

Engineer, No. 4120, December 28, p. 641.

Revolutionary changes in **steel making.** (4 300 words.)

1934 **621 .43 (.42**

Engineer, No. 4120, December 28, p. 651.

Oil locomotive for the Air Ministry. (500 words & fig.)

1935 **624 (**

Engineer, No. 4121, January 4, p. 4.

Bridges and tunnels of 1934. (4 300 words & fig.)

1935 **621 .3**

Engineer, No. 4121, January 4, p. 10.

Hydro-electric power schemes in 1934. (2 500 words & fig.)

1935 **621 .13 (0 & 621 .43 (0**
Engineer, No. 4121, January 4, p. 16.
Locomotives and railcars of 1934. (2 400 words & fig.)

1935 **627**
Engineer, No. 4121, January 4, p. 21; No. 4122, January 11, p. 35.
Harbours and waterways in 1934. — No. 1. (7 600 words.)

1935 **621 .3**
Engineer, No. 4121, January 4, p. 23; No. 4122, January 11, p. 50.
Electrical engineering in 1934. — No. 1. (6 800 words & fig.)

1935 **656 .1 (.42) & 656 .28 (.42)**
Engineer, No. 4122, January 11, p. 45.
Road traffic and road accidents. (1 200 words.)

1935 **656 283 (.42)**
Engineer, No. 4122, January 11, p. 45.
The Winwick Junction **railway accident.** (1 400 words.)

1935 **656 .1**
Engineer, No. 4122, January 11, p. 53.
O'GORMAN (Col. M.). — Bringing science into the **road traffic problem.** (3 200 words.)

Engineering. (London.)

1934 **621 .335 (.42) & 621 .43 (.42)**
Engineering, No. 3597, December 21, p. 672.
Armstrong Whitworth **Diesel-electric rail units.** (2 400 words & fig.)

1934 **621 .9**
Engineering, No. 3597, December 21, p. 676.
The Sirocco **portable pneumatic conveyance unit.** (900 words & fig.)

1934 **625 .23**
Engineering, No. 3597, December 21, p. 681.
Streamlined trains. (2 400 words.)

1934 **621 .43**
Engineering, No. 3597, December 21, p. 684.
Air swirl in oil engines. — Paper read by Mr. J. F. ALCOCK at the Institution of Mechanical Engineers, London, the 14th December 1934. (5 600 words.)

1934 **62. (01 & 669 .1**
Engineering, No. 3597, December 21, p. 689; No. 3598, December 28, p. 703.
HALLAM (H.). — **Researches in impact testing.** (4 200 words & fig.)

1934 **621 .43**
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ALCOCK (J. F.). — **Air swirl in oil engines.** — Paper read at the Institution of Mechanical Engineers, December 14, 1934. Abridged. (2 800 words.)

1934 **621 .31**
Engineering, No. 3597, December 21, p. 695; No. 3598, December 28, p. 721.
The International Union of Power Producers and Distributors. (5 500 words & fig.) (To be continued.)

1934 **621 .31 (.73)**
Engineering, No. 3598, December 28, p. 697.
JORGENSEN (L.). — **2 560-ft. fall hydro-electric power development.** (2 000 words & fig.)

1934 **62. (01 & 669 .1**
Engineering, No. 3598, December 28, p. 698.
HAIG (B. P.). — **Fatigue in structural steel.** (3 700 words, fig. & tables.)

1934 **62. (01 & 621 .6**
Engineering, No. 3598, December 28, p. 701.
The Venturiflume meter. (4 200 words & fig.)

1934 **621 .9 (.43)**
Engineering, No. 3598, December 28, p. 719.
Recent developments in German **woodworking machinery.** (1 900 words & fig.)

1935 **53 (06 (.42)**
Engineering, No. 3599, January 4, p. 1.
The Physical Society's Exhibition. (2 200 words & fig.)

1935 **621 .9 & 621 .134.1**
Engineering, No. 3599, January 4, p. 21.
Centrifugal babbiting **machine for connecting rods.** (600 words & fig.)

1935 **621 .392 & 621 .9**
Engineering, No. 3599, January 4, p. 26.
Electric welding attachment for machine tools. (600 words & fig.)

1935 **621. (064 (.73)**
Engineering, No. 3600, January 11, p. 35.
Power and Mechanical Engineering Exhibition, New York. (5 000 words & fig.)

1935 **621 .43 (.42)**
Engineering, No. 3600, January 11, p. 46.
260-h.p. **railcar** for the Great Western Ry. (England). (2 300 words & fig.)

Engineering News-Record. (New York.)

1934 **721 .3 & 721 .9**
Engineering News-Record, No. 24, December 13, p. 760.
LOHR (W. S.). — **Concrete columns** encased in steel shells proposed. (3 400 words & fig.)

1934 **625 .13 (.73)**
Engineering News-Record, No. 25, December 20, p. 785.
Old **swing span** moved upstream for road detour. (2 300 words & fig.)

1934 **624 .9 (.73)**
Engineering News-Record, No. 25, December 20, p. 793.
Traveler on new low roof removes old **arch trusses** (Trainshed of La Salle Street Station, Chicago). (1 800 words & fig.)

1934 **624. (0 (.42)**
Engineering News-Record, No. 25, December 20, p. 795.
Steel bridge trends in Great Britain. (400 words.)

Journal, Institution of Engineers, Australia. (Sydney, N. S. W.)

1934 **62. (01 & 621 .392**
Journal, Institut. of Engineers, Australia, November, p. 421.
BLACKWOOD (R. R.). — The effect of **welding** variables on the physical properties of electric arc weld metals. (8 700 words, tables & fig.)

1934 **625 .7 & 656 .1**
Journal, Institut. of Engineers, Australia, December, p. 476.
HAWLEY (L. W.). — The organization of **motor transport**, in the carrying out of road works. (7 800 words, 11 tables & fig.)

Mechanical Engineering. (New York.)

1935 **621 .43**
Mechanical Engineering, January, p. 46.
Converting air-injection to airless Diesel engines. (1 800 words & fig.)

Modern Transport. (London.)

1934 **625 .232 (.68)**
Modern Transport, No. 823, December 22, p. 3.
Second-class vehicles for day and night express services, South African Rys. (900 words & fig.)

1934 **656 .212 (.42) & 656 .225 (.42)**
Modern Transport, No. 823, December 22, p. 4.
Development of freight traffic. — Railway methods reviewed. (1 200 words.)

1934 **625 .616 (.54)**
Modern Transport, No. 823, December 22, p. 5.
Standard **light goods locomotives** for India. — Class « XD » engines for South Indian Railway. (500 words & fig.)

1934 **621 .131.3 (.42 + .44)**
Modern Transport, No. 823, December 22, p. 7.
L. N. E. R. locomotive in France. — Tests in progress at Vitry. (350 words & fig.)

1934 **621 .132.5 (.68) & 621 .134.3 (.68)**
Modern Transport, No. 824, December 29, p. 5.
British-built locomotives for South Africa. — Fifty **4-8-2 type engines** with poppet valve gear. (850 words & fig.)

1934 **621 .392**
Modern Transport, No. 824, December 29, p. 7.
Electric welding of rolling stock. Progress at home and abroad. (1 300 words & fig.)

1935 **38 (06**
Modern Transport, No. 825, January 5, p. 3.
WOHL (P.). — **International aspect of transport.** — Organisations and their purposes. (1 500 words.)

1935 **621 .138.3 (.436)**
Modern Transport, No. 825, January, p. 5.
Economy in locomotive boiler maintenance. — Austrian Railway practice. (1 350 words & fig.)

1935 **656 (.41)**
Modern Transport, No. 826, January 12, p. 3.
Transport co-ordination in Irish Free State. (4 200 words.)

1935 **656 .25 (.42) & 656 .273 (.42)**
Modern Transport, No. 826, January 12, p. 5.
TATTERSALL (A. E.). — New methods in **railway signalling.** — Economy on branch lines. (2 400 words.)

1935 **625 .14 (.73) & 656 .222.1 (.73)**
Modern Transport, No. 826, January 12, p. 7.
Adapting a railway for **high-speed trains.** (2 300 words.)

1935 **656 .1 (.43)**
Modern Transport, No. 826, January 12, p. 13.
Road construction in Germany. — Task of the National Railways. (1 300 words.)

Proceedings, American Society of Civil Engineers. (London.)

1934 **624 .6**
Proceedings, Amer. Soc. of Civil Engineers, December, p. 1403.
HRENNIKOFF (A.). — **Analysis of multiple arches.** (5 600 words, tables & fig.)

1934 **721 .3**
Proceedings, Amer. Soc. of Civil Engineers, December, p. 1421.
YOUNG (D. H.). — Rational design of **steel columns.** (2 800 words & fig.)

1934 **624 .63**
Proceedings, Amer. Soc. of Civil Engineers, December, p. 1496.
Laboratory tests of multiple-span **reinforced concrete arch bridges,** by W. M. WILSON. — Discussion by M. HIRSCHTHAL. (1 000 words.)

1934 **721 .2**
Proceedings, Amer. Soc. of Civil Engineers, December, p. 1509.
PIPPARD (A. J. S.). — Determination of trapezoidal profiles for **retaining walls.** — Discussion by LINDLEY (E. S.) & DE BLOIS (K. L.). (400 words & fig.)

Railway Age. (New York.)

1934 385 .1 (.73)
ailway Age, No. 22, December 1, p. 663.
A series of 20 articles dealing with the following sub-ects : national recovery and the railroads — Railway arnings determine railway purchases — what the rail-oads want to buy — other factors in transport pro-lem.

1934 625 .2 & 669 .1
ailway Age, No. 23, December 8, p. 761.
SCHRAMM (G. N.), TAYLERSON (E. S.) & STRUE-ING (A. F.). — New **alloy steels** and their application o car equipment. (5 300 words, 4 tables & fig.)

1934 625 .111 (.73)
ailway Age, No. 23, December 8, p. 766.
RIDGWAY (A.). — The Dotsero cutoff — A special roblem in **railway location.** (3 300 words & fig.)

1934 656 .225 (.73)
ailway Age, No. 24, December 15, p. 791.
Co-ordinated **fast-freight handling system** developed. 1 200 words & fig.)

1934 625 .1 (.73) & 656 .222.1 (.73)
ailway Age, No. 24, December 15, p. 795.
Making 60-mile track good for 100 miles an hour. 2 500 words & fig.)

1934 656 .255 (.73)
ailway Age, No. 24, December 15, p. 797.
Centralized traffic control installed on the Alton. 900 words & fig.)

1934 621 .133.7 (.73)
ailway Age, No. 24, December 15, p. 800.
Locomotive **water conditioner** improved. (800 words fig.)

1934 621 .139 (.73) & 625 .27 (.73)
ailway Age, No. 24, December 15, p. 801.
Supplies big factor in C. & N. W. (U. S. A.) opera-ons. (1 100 words & fig.)

1934 627 (.73) & 656 .213 (.73)
ailway Age, No. 25, December 22, p. 820.
Pennsylvania builds large modern **marine pier** at Bal-more. (3 200 words & fig.)

1934 621 .132.8 (.73)
ailway Age, No. 25, December 22, p. 825.
New York Central « **streamlines** » **passenger loco-otive.** (1 200 words & fig.)

1934 656 .261 (.73)
ailway Age, No. 25, December 22, p. 830.
Cincinnati terminals motorized. (1 900 words & fig.)

1934 656 .261 (.73)
ailway Age, No. 25, December 22, p. 833.
Union Pacific a **storedoor pioneer.** (2 200 words & fig.)

1934 621 .132.3 (.73)
Railway Age, No. 26, December 29, p. 851.
High speed Pacific type locomotives received by Boston & Maine. (1 000 words, 1 table & fig.)

1934 625 .17 (.73)
Railway Age, No. 26, December 29, p. 853.
CLARKE (H. S.). — Progress in track, maintenance must continue. — **Long rails, with welded joints,** held out as practicable and offering large economies. (2 800 words.)

1934 656 .258 (.73)
Railway Age, No. 26, December 29, p. 861.
Junction controlled remotely on Lehigh Valley. (1 100 words & fig.)

1934 385 .21 (.73)
Railway Age, No. 26, December 29, p. 863.
New **waterway** policy recommended. (8 900 words.)

Railway Engineer. (London.)

1935 698
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BASSETT (H. N.). — **Paints** for water tank inte-riors. (1 600 words & fig.)

1935 625 .245 (.492)
Railway Engineer, January, p. 406.
Welded steel hopper wagons. (350 words & fig.)

1935 621 .87 (.83)
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Heavy German **breakdown cranes.** (400 words & fig.)

1935 621 .131.3 & 621 .133.1
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Practical locomotive tests (II). — Consumptions. (1 700 words & 3 tables.)

1935 625 .1 (.45)
Railway Engineer, January, p. 411.
The **Fossano-Ceva line** of the Italian State Railways. (1 200 words & fig.)

1935 62. (01 & 669 .1
Railway Engineer, January, p. 413.
ALLEN (C. J.). — A new **heat treatment** for ferrous metals. (1 400 words.)

1935 625 .212 & 669 .1
Railway Engineer, January, p. 414.
DOWNIE (C. C.). — **Shrinking wheel tyres.** (1 500 words & fig.)

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Railway Engineer, January, p. 416.
Improvements in the locomotive **blast pipe.** (1 200 words & fig.)

1935 **625 .215**
Railway Engineer, January, p. 420.
Continental locomotive trucks. — A description of the Krauss and Zara **trucks.** (2 000 words & fig.)

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Railway Engineer, January, p. 425.
PORTER (the late S. R. M.). — **The mechanics of a locomotive in curved track** — VI. (2 800 words & fig.)

1935 **656 .253 (.485)**
Railway Engineer, January, p. 428.
Electric power signalling at Stockholm Central. (2 200 words & fig.)

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1934 **625 .144 (.73)**
Railway Engineering & Maintenance, December, p. 693.
A reporter views railroad's struggles during hardest winter. (3 200 words & fig.)

1934 **625 .143.1**
Railway Engineering & Maintenance, December, p. 696.
Can rail be standardized ? (4 300 words & fig.)

1934 **624 .1 (.73) & 624 .9 (.73)**
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WESTFALL (C. C.). — **Novel roller-mounted drivers place** 13 800 **long piles.** (2 300 words & fig.)

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1934 **625 .172**
Railway Gazette, No. 25, December 21, p. 1013.
Hallade permanent way maintenance. (600 words.)

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Railway Gazette, No. 25, December 21, p. 1020.
ARTHURTON (A. W.). — Impressions of overseas transport. — V. Agricultural Canada seen from the observation car of the Continental Limited. (1 200 words.)

1934 **625 .232 (.68)**
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New rolling stock for South Africa. (1 000 words & fig.)

1934 **621 .132.5 (.54)**
Railway Gazette, No. 25, December 21, p. 1029.
New 2-8-2 type freight **locomotive** for South India. (350 words & fig.)

1934 **656 .222.5 (.4)**
Railway Gazette, No. 25, December 21, p. 1034.
The development of European express passenger train services, 1914-1934. (3 800 words & 4 tables.)

1934 **625 .1 (.∞**
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Ten years of **progress** in **permanent way** practic abroad. (1 500 words.)

1934 **385 (.43**
Railway Gazette, No. 26, December 28, p. 1054.
German Railway development programme. (1 30 words.)

1934 **656 .254 (.42**
Railway Gazette, No. 26, December 28, p. 1055.
Carrier current **telephony** on the L. N. E. Ry. (60 words & fig.)

1934 **656 .234 (.42**
Railway Gazette, No. 26, December 28, p. 1056.
PHILLIMORE (J.). — Early British **railway ticket** (2 700 words & fig.)

1934 **385 (091 (.73**
Railway Gazette, No. 26, December 28, p. 1059.
ARTHURTON (A. W.). — Impressions of oversea transport. — VI. The Continental Limited in th Rocky Mountains. A landslide ahead and a broke bridge in the rear temporarely bar the way. (1 70 words.)

1934 **656 .256 (.44**
Railway Gazette, No. 26, December 28, p. 1063.
Signalling and block working in France. (5 200 word & fig.)

1935 **385. (091 (.71**
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ARTHURTON (A. W.). — Impressions of oversea transport. — VII. The importance of Montreal as transport centre has led to the development of man activities in which the city claims to lead the worl (1 100 words.)

1935 **656 .259 (.43**
Railway Gazette, No. 1, January 4, p. 12.
Checking speed restrictions. (1 200 words & fig.)

1935 **625 .3 (.931**
Railway Gazette, No. 1, January 4, p. 14.
The Rimutaka incline. (1 400 words & fig.)

1935 **621 .132.3 (.438**
Railway Gazette, No. 1, January 4, p. 16.
New **2-10-2 type locomotives** for the Polish Stat Railways. (600 words & fig.)

1935 **624 .7 (.42**
Railway Gazette, No. 1, January 4, p. 22.
An unusual **overline bridge.** (500 words & fig.)

1935 **621 .138.5 (.62**
Railway Gazette, No. 1, January 4, p. 23.
Colour control of **limit gauging.** (1 400 words.)

1935 385. (.42)
Railway Gazette, No. 2, January 11, p. 47.

BYLES (C. B.). — **British railways after 25 years.** — Road competition — Passenger fares — Advertising — Dirty locomotives and stations — London's « Underground » — Signalling developments — Automatic train control — Courtesy of the staff. (2 200 words.)

1935 621 .132.3 (.54) & 621 .132.6 (.729)
Railway Gazette, No. 2, January 11, p. 49.

New British-built locomotives for overseas railways. (900 words & fig.)

1935 625 .614 (.54)
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Lubricated checkrails to reduce **curve wear.** (1 200 words & fig.)

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Railway Gazette, No. 2, January 11, p. 58.

Lagny railway disaster trial. (1 800 words.)

1935 656 .283 (.42)
Railway Gazette, No. 2, January 11, p. 59.

Ministry of Transport **accident report.** Winwick junction, London Midland & Scottish Ry. : September 28, 1934. (2 400 words & fig.)

1934 621 .43 (.42)
Diesel Ry. Traction, p. 1079, Suppl. to the Ry. Gazette, December 28.

The L. M. S. Ry. **Diesel shunting locomotives.** (800 words & fig.)

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Diesel Ry. Traction, p. 1081, Suppl. to the Ry. Gazette, December 28.

Latest developments of the **Ganz car** in Hungary. (700 words & fig.)

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Progress in **engine design.** (1 000 words & fig.)

1934 621 .43 (.42)
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Diesel traction in Great Britain. (1 400 words.)

1934 621 .43 (.73)
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North American **high-speed trains** of 1934. (1 200 words & fig.)

1934 621 .43 (.44)
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French **Diesel railcar** practice. (800 words, 1 table & fig.)

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Diesel traction activities in South America. (1 200 words & fig.)

1934 621 .43 & 625 .216
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A new **automatic coupler** for Diesel stock. (400 words & fig.)

1935 621 .33 (.73)
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SIMONS (R. L.). — The fastest **electric service** in the world. (3 600 words & fig.)

1935 621 .33 (.45)
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Aosta-Pré St-Didier **electric railway.** (600 words & fig.)

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Railway Magazine, January, p. 7.

ALLEN (C. J.). — A new « **record of records** ». — London to Leeds in 2 hours 32 minutes. (2 800 words & fig.)

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Heavy **4-8-4 locomotives** for the Northern Pacific. (1 600 words, tables & fig.)

1934 625 .212
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GRAY (W. E.). — Determining **car-wheel eccentricity.** (2 600 words, 3 tables & fig.)

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WRIGHT (G. I.) & McGEE (P. A.). — Motive power requirements for **high-speed trains.** — Part I. (3 800 words & fig.) (To be continued.)

Railway Signaling. (Chicago.)

1934 **656** .256.3 (.73)
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Automatic interlocking in the Texas Panhandle. (3 400 words & fig.)

1934 **656** .258 (.73)
Railway Signaling, December, p. 591.
An **electric interlocking** on the Southern Pacific. (1 800 words & fig.)

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Railway Signaling, December, p. 593.
TATERSALL (A. T.). — **Highway crossing protection** in England. (1 000 words & fig.)

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Crossing signals on the Nickel Plate. (1 100 words & fig.)

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End-of-double-track switch controlled automatically. (1 300 words & fig.)

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Railway Signaling, December, p. 602.
Centralized traffic control on the Texas & New Orleans. (1 700 words & fig.)

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1934 **625** .62 (.73)
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1934 **625** .214
Anales de la Asociación de Antiguos Alumnos, nov., p. 598; dic., p. 653.
FLORES (M. M.). — **Cojinetes de bolas y rodillos.** (9 200 palabras, 2 cuadros & fig.) (Continuará.)

1934 **621** .335 (.460)
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JACKSON (L.) & LLANOS (S.). — **Locomotoras eléctricas** de la Compañia de los Caminos de hierro del Norte de España. (2 100 palabras & fig.) (Continuará.)

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MONREAL (M.) & CASTILLO (M.). — La cr **ferroviaria** y sus posibles remedios. (1 400 palabras fig.) (Continuará.)

Ferrocarriles y Tranvias. (Madrid.)

1934 **621**
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ALEIXANDRE (A. M.). — **Transmisiones hidráu** cas para automotores. (8 700 palabras & fig.)

1934 **385** (.46
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Bases para una sana ordenación ferroviaria. (4 palabras & fig.)

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GOICOECHEA (A.). — Contra el **peso muerto** coches y vagones. (3 600 palabras & fig.)

1935 **621** .43 (.46
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1934 **625** .
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Averías en los vagones. — Vagones cubas. (1 100 p labras & fig.) (Continuará.)

1935 **656** .
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MERINO (J.). — **Teorética del tráfico.** (2 100 pa bras & fig.)

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1935 **621 .43**
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DONATO (L. F.). — Sul controllo in cantiere dei cementi e degli inerti da conglomerato. (6 400 parole & fig.)

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1934 **625 .2 (01 & 625 .215**
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DEL GUERRA (G.). — La **circolazione dei veicoli** a tre o piú sale indipendenti sulle curve di raggio molto piccolo. (4 600 parole & fig.)

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LANDRA (A.). — Il nuovo testo di condizioni e tariffe per il **trasporto delle persone e la C.I.V.** (3 200 parole.)

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GIOVENE (N.). — La **vita della locomotiva.** (2 400 parole & fig.)

1934 **621 .134.1**
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DIEGOLI (M.). — **I cuscinetti delle bielle nelle locomotive veloci.** Sollecitazioni, Lubrificazione. Riscaldi. (11 000 parole & fig.)

In Dutch.

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De Ingenieur, Nr 1, 4 Januari, p. Bt. 1.
FROEHLICH (O. K.). — Over de **doorlaatbaarheid van beton** voor water en de capillaire stijghoogte. (1 900 woorden & fig.)

1935 **669 .1**
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SCHÖNROCK (K.). — Herstellung und Eigenschaften des **Istegeisens.** (3 000 woorden & fig.)

1935 **669 .1 & 691**
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EMPERGER (F.). — Die Verwendung von hochwertigem Stahl im **Eisenbeton** und die **Rissfrage.** (1 400 woorden.)

1935 **624 .32 (.492)**
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MUNDT (Th. W.). — De **nieuwe spoorbrug** over den IJssel bij Hattemerbroek. (3 000 woorden & fig.)

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1935 **623 (.492)**
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1935 **625 .1 (.45)**
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De « **Direttissima** » Bologna-Firenze. (1 900 woorden & fig.)

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Spoor- en Tramwegen, Nr 1, 1 Januari, p. 7.
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Spoor- en Tramwegen, Nr 2, 15 Januari, p. 29; Nr 3, 29 Januari, p. 63.
DE GRAAFF (W. J.). — **Algemeene Transport Onderneming** en van Gend & Loos. (7 400 woorden & fig.)

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Spoor- en Tramwegen, Nr 2, 15 Januari, p. 36.

DE JONG (L. C.). — **1 D 1 Tender-locomotieven** werkende met oververitte stroom voor de Staatsmijnen in Limburg. (1 300 woorden & fig.)

1935 **656 .2 (.43)**

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In Polish.

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1935 **625 .172 = 91 .885**

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1934 **624 .3 (.67**

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ORNELLAS (C. d'). — **A maior ponte do mundo** n é a do Zambeze mas sim a do « Ferrocarril do Ult mar ». (1 400 palavras & fig.)

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Index to A. S. T. M. standards and tentative standards as of January 1, 1935.

Philadelphia. Offices of the Society.

(1) The numbers placed over the title of each book are those of the decimal classification proposed by the Railway Congress conjointly with the Office Bibiagraphique International, of Brussels. (See « Bibliographical Decimal Classification as applied to Railway Science », by L. Weissenbruch, in the number for November 1897, of the *Bulletin of the International Railway Congress*, p. 1509).

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The theory of vibrations for engineers.

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La **suppression du passage à niveau** de Myennes, sur la ligne de Paris à Nevers, du réseau P. L. M. (700 mots et fig.)

1935 **62. (01 & 669**
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Micromachine à enregistrement photographique pour **l'essai mécanique des métaux.** (3 000 mots et fig.)

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MARTIN (H.). — Les **améliorations apportées aux locomotives Pacific** de la Compagnie des Chemins de fer du P. O.-Midi et la **transformation de certaines d'entre elles en locomotives à vapeur à quatre essieux accouplés.** (7 400 mots et fig.)

1935 **621 .335**
Génie civil, n° 2742, 2 mars, p. 211.
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1935 **625 .2**
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1935 **625 .2**
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Les Chemins de fer et les Tramways, février, p. 29.
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1935 **621 .43**
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SPIESS (E.). — **Automotrices Diesel.** (10 000 mots et fig.)

1935 **621 .43**
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KEULEYAN (L.). — **Comparaison de quelques automotrices** à différents modes de transmission. (1 600 mots et fig.)

1935 **669**
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Note sur un **alliage inaltérable** à la vapeur et aux gaz d'échappement. (3 600 mots et fig.)

1935 **693**
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CHARBIN (V.). — **Etanchéité des maçonneries** des voies ferrées, notamment des tunnels. (1 300 mots.)

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LEVI (R.). — Etude relative au **contact des roues sur le rail.** (13 000 mots et fig.)

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CHAPELON (A.). — **Locomotives à grande vitesse** à bogie et 4 essieux accouplés compound à 4 cylindres à large circuit de vapeur, haute surchauffe et distribution par soupapes provenant de la transformation des locomotives « Pacific » à roues motrices de 1.85 m. de diamètre, série 4501 à 4570, de la Compagnie d'Orléans. (36 000 mots et fig.) (A suivre.)

1935 **621 .33 (.47**
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GRETSCH. — Das **Londoner Personenverkehrs-Am** und das Londoner Personenverkehrs-Gesetz 1933. (23 30 Wörter & Karte.) (Fortsetzung folgt.)

1934 **385 .517 (.43**
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KUHATSCHECK (O.). — Die **Kranken- und Arbeiterpensionskassen, die Angestelten-, Unfall- und Arbeitslosenversicherung** bei der Deutschen Reichsbahn im Jah 1933. (15 600 Wörter.)

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1935 **313 .385 (.3)**

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GOLZ (J.). — **Bahnpolizei** und allgemeine **Polizei.** (13 700 Wörter.)

1935 **388 (.42)**

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GRETSCH. — Das **Londoner Personenverkehrs-Amt** und das Londoner Personenverkehrs-Gesetz 1933. (8 800 Wörter.) (Fortsetzung folgt.)

1935 **313 .385 (.43)**

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VON RENESSE. — Die **Eisenbahnen** des Deutschen Reichs 1932. (7 400 Wörter.)

1935 **385 .113 (.493)**

Archiv für Eisenbahnwesen, Januar-Februar, S. 123.

VON RENESSE. — Die **nationale Gesellschaft** der **belgischen Eisenbahnen** im sechsten Geschäftsjahr (1. Januar bis 31. Dezember 1932), dargestellt auf Grund des Geschäftsberichts der Gesellschaft und des Berichts des Verwaltungsrats. (5 000 Wörter.)

1935 **385 .113 (.437)**

Archiv für Eisenbahnwesen, Januar-Februar, S. 141.

Die **Eisenbahnen der tschechoslowakischen Republik** im Jahr 1932. (10 000 Wörter.)

1935 **385 (.496 + .56)**

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DIECKMANN (R.). — Die **türkischen Staatsbahnen** von 1923 bis 1933. (4 600 Wörter & Karte.)

1935 **385 (.59)**

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KANDAOUROFF (P.). — Die **Malayschen Eisenbahnen.** (6 500 Wörter & Abb.)

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1935 **656 .215 (.43)**

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DORENBERG (K.). — Vollselbsttätige Dieselsätze für die **Notbeleuchtung des Hauptbahnhofs** Duisburg. (2 500 Wörter & Abb.)

1935 **621 .94 (.93) & 621 .138.5 (.43)**

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SCHMIDT (D.). — Spitzenlose Dreh- und Prägepolierbank zur **Bearbeitung der Achsschenkel** von Lokomotiv-Radsätzen. (2 600 Wörter & Abb.)

1935 **621 .135.1 & 621 .138.5**

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GAEBLER (G. A.). — Das **Anheben von Lokomotiven** mit Barrenrahmen und die dabei zu erwartenden **Biegebeanspruchungen des Rahmens.** (1 200 Wörter & Abb.) (Schluss folgt.)

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1935 **621 .43**

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SPIES (R.). — Neuere **Flüssigkeitsgetriebe** für Eisenbahnfahrzeuge mit Antrieb durch Verbrennungsmotor. (6 300 Wörter & Abb.)

1935 **621 .35 & 621 .43**

Organ für die Fortschritte des Eisenbahnwesens, Heft 4, 15. Februar, S. 67.

MÜLLER (E.). — **Umbau** einer **Triebwagenladeanlage** für Eilaufladung. (2 900 Wörter, 4 Tafeln & Abb.)

1935 **621 .35 (.43) & 621 .43 (.43)**

Organ für die Fortschritte des Eisenbahnwesens, Heft 4, 15. Februar, S. 72.

WILL (F.). — Die neue **Triebwagenladeanlage** bei dem Bahnbetriebswerk Bamberg. (1 700 Wörter & Abb.)

1935 **625 .113 & 625 .151**

Organ für die Fortschritte des Eisenbahnwesens, Heft 5, 1. März, S. 14.

LEISNER. — Die Bogenweiche, Bogenkreuzung und Bogenkreuzungsweiche im **Ubergangsbogen.** (5 000 Wörter & Abb.)

1935 **625 .113**

Organ für die Fortschritte des Eisenbahnwesens, Heft 5, 1. März, S. 89.

LEISNER. — Die **Geometrie des Gleisbogens** für hohe Geschwindigkeiten. (2 300 Wörter & Abb.)

1935 **625 .14 (01**

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HANKER (R.). — Einheitliche **Langträgerberechnung des Eisenbahnoberbaues.** (2 800 Wörter & Abb.)

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1935 **621 .392 (.43) & 665 .882 (.43)**

Zeitsch. des Ver. deutsch. Ing., Nr. 7, 16. Februar, S. 187.

HILPERT (A.) & ADRIAN (W.). — Zehn Jahre deutscher **Schweisstechnik.** (4 100 Wörter & Abb.)

1935 **621 .4**

Zeitsch. des Ver. deutsch. Ing., Nr. 7, 16. Februar, S. 205.

FINKBEINER (H.). — Versuche und Erfahrungen mit **Holzgas** zum **Betrieb** von **Verbrennungsmotoren.** (2 800 Wörter & Abb.)

1935 **656 .1 (.43)**

Zeitsch. des Ver. deutsch. Ing., Nr. 7, 16. Februar, S. 210.

GERLACH (E.). — Der **Berliner Reichsautobahnring.** (2 000 Wörter & Abb.)

1935 **621 .94**

Zeitsch. des Ver. deutsch. Ing., Nr. 8, 23. Februar, S. 220.

FEHSE (A.). — **Drehbänke und Automaten.** (9 000 Wörter & Abb.)

1935 **621 .91**

Zeitsch. des Ver. deutsch. Ing., Nr. 8, 23. Februar, S. 233.

BAHLECKE (F.). — **Fräs-, Hobel- und Bohrmaschinen.** (3 100 Wörter & Abb.)

1935 **621 .94**

Zeitsch. des Ver. deutsch. Ing., Nr. 8, 23. Februar, S. 255.

KRUG (C.). — Fragen der **Schleiftechnik.** (3 500 Wörter & Abb.)

1935 **621 .116 (.43)**

Zeitsch. des Ver. deutsch. Ing., Nr. 9, 2. März, S. 276.

SCHULTES (W.). — Wirtschaftlichkeit von Erneuerungen im **Dampfkesselbetrieb.** (3 200 Wörter & Abb.)

Zeitschrift für das gesamte Eisenbahn-Sicherungswesen. (Berlin.)

1935 **656 .25 (0 (.43)**

Zeitschrift für das gesamte Eisenbahn-Sicherungswesen, Nr. 2, 1. Februar, S. 13; Nr. 3, 20. Februar, S. 25.

BESSER (F.). — Das neue **Signalbuch.** (12 000 Wörter & Abb.)

Zeitung des Vereins Mitteleuropäischer Eisenbahnverwaltungen. (Berlin.)

1935 **656 (.4)**

Zeitung des Vereins mitteleuropäischer Eisenbahnverw., Nr. 3, 17. Januar, S. 61.

von BECK (E.). — Die Auseinandersetzung zwischen **Schiene und Lastkraftwagen** in den ausserdeutschen europäischen Ländern. (9 500 Wörter.)

1935 **656 (.43)**

Zeitung des Vereins mitteleuropäischer Eisenbahnverw., Nr. 4, 24. Januar, S. 85.

ZÄPFEL. — Das Gesetz über die **Beförderung von Personen** zu Lande. (1 900 Wörter.)

1935 **385 .1 (.43)**

Zeitung des Vereins mitteleuropäischer Eisenbahnverw., Nr. 5, 31. Januar, S. 101; Nr. 6, 7. Februar, S. 125.

BUSCH. — Die Vereinheitlichung und Fortentwicklung der **Finanzvorschriften** bei der Deutschen Reichsbahn. (12 600 Wörter.)

1935 **656 .225 & 656 .261**

Zeitung des Vereins mitteleuropäischer Eisenbahnverw., Nr. 6, 7. Februar, S. 108.

BURGER. — Der **Kleinbehälter** auf dem Vormarsch. (1 200 Wörter.)

1935 **656 .1 (.43)**

Zeitung des Vereins mitteleuropäischer Eisenbahnverw., Nr. 7, 14. Februar, S. 141.

JOSEPH (K.). — Gedanken zum Problem der **Personentarife auf den Reichsautobahnen.** (5 000 Wörter.)

1935 **656 .222.5 (.43)**

Zeitung des Vereins mitteleuropäischer Eisenbahnverw., Nr. 7, 14. Februar, S. 147.

WENTZEL. — **Eisenbahnwerbung** und Fahrplanbekanntgabe. (900 Wörter.)

1935 **656 (.43)**

Zeitung des Vereins mitteleuropäischer Eisenbahnverw., Nr. 8, 21. Februar, S. 161.

FRITZE. — Die Organisation der **Personenverkehrswerbung** im Reichsbahndirektionsbezirk Erfurt. (2 300 Wörter.)

1935 **656 .225 (.43)**

Zeitung des Vereins mitteleuropäischer Eisenbahnverw., Nr. 9, 28. Februar, S. 177.

MEYER (R.). — Dienst am Kunden durch die **Reichsbahn-Auskunftei für Güterverkehr.** (1 100 Wörter.)

1935 **625 .4**

Zeitung des Vereins mitteleuropäischer Eisenbahnverw., Nr. 9, 28. Februar, S. 185.

BULLEMER. — Neue **Untergrundbahnen** in den östlichen Weltstäden. (1 100 Wörter & Abb.)

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1935 **3 (06 (.73), 38 (.73) & 654 (.73)**

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1935 **53 (064 (.42)**

Engineer, No. 4123, January 18, p. 68.

The Physical Society's Exhibition. (4 000 words & fig.)

1935 **621 .33 (.42)**

Engineer, No. 4123, January 18, p. 73.

Suburban **railway electrification.** (900 words.)

1935 **625 .162 & 656 .25**

Engineer, No. 4123, January 18, p. 74.

RYVEL (R. A.). — Protective **measures at level crossings.** (1 800 words.)

1935 **385 .111 (.42)**
Engineer, No. 4123, January 18, p. 77.
British Railways in 1934. (2 600 words.)

1935 **624 .2**
Engineer, No. 4124, January 25, p. 94.
EVANS (R. H.). — **Strain and stress distribution in concrete beams.** (4 200 words, 1 table & fig.)

1935 **621 .39**
Engineer, No. 4124, January 25, p. 102.
Short-circuit testing installation. (2 000 words & fig.)

1935 **385 .51 (.42)**
Engineer, No. 4125, February 1, p. 125.
Railway conciliation machinery. (1 500 words.)

1935 **621. (06 (.42) & 621 .18**
Engineer, No. 4125, February 1, p. 126.
Treatment and control of boiler water. (2 500 words.)

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Engineer, No. 4125, February 1, p. 131.
GLINN (R. J.). — Care of modern **steam generating plant** from the water side. Paper read at the Institution of Mechanical Engineers, January 25, 1935. (5 700 words & fig.)

1935 **625 .23**
Engineer, No. 4126, February 8, p. 151.
Railway coaches. (1 300 words.)

1935 **627 .82 (.73)**
Engineer, No. 4126, February 8, p. 155; No. 4127, February 15, p. 171; No. 4128, February 22, p. 196.
Progress on the Boulder dam. (5 900 words & fig.) (To be continued.)

1935 **621 .165**
Engineer, No. 4127, February 15, p. 165; No. 4128, February 22, p. 190.
The development of Parsons industrial **turbo machinery.** (6 700 words & fig.) (To be continued.)

1935 **625 .162 & 656 .286**
Engineer, No. 4127, February 15, p. 175.
Railway level crossings. (1 200 words.)

1935 **621 .43**
Engineer, No. 4127, February 15, p. 182.
A hydraulic transmission unit (Haslam & Newton, Ltd.). (2 800 words & fig.)

1935 **656 .283 (.42)**
Engineer, No. 4128, February 22, p. 194 & 201.
The Port Eglinton Junction **railway collision.** (2 300 words & fig.)

1935 **62. (01**
Engineer, No. 4128, February 22, p. 202.
HAAS (A.). — **Representative samples and commercial testing.** (3 400 words & fig.)

1935 **621 .43 (.42)**
Engineer, No. 4128, February 22, p. 207.
A railcar with pneumatic tires. (500 words & fig.)

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1935 **621 .94**
Engineering, No. 3601, January 18, p. 58.
Precision **profile-grinding machine.** (2 200 words & fig.)

1935 **53 (064 (.42)**
Engineering, No. 3601, January 18, p. 79.
The Physical Society's Exhibition. (4 700 words & fig.) (To be continued.)

1935 **621 (06 (.73)**
Engineering, No. 3601, January 18, p. 87.
Power and Mechanical Engineering Exhibition, New York. (3 900 words.) (To be continued.)

1935 **665 .882**
Engineering, No. 3602, January 25, p. 99.
Oxy-ferrolene cutting and welding. (600 words & fig.)

1935 **62. (01, 621 .392 & 624 .92**
Engineering, No. 3602, January 25, p. 101.
The relative rigidity of **welded and riveted connections.** (1 800 words & fig.)

1935 **621 .9**
Engineering, No. 3603, February 1, p. 107.
TOWN (H. C.). — **Measurement during machining and automatic sizing.** (1 800 words & fig.)

1935 **621. (06 (.42) & 62 .18**
Engineering, No. 3603, February 1, p. 122.
The Institution of Mechanical Engineers, January 25, 1935.
GLINN (R. J.). — **Water conditioning** for boiler plants. Paper read at. (7 200 words & fig.)

1935 **621 .392 & 721 .9**
Engineering, No. 3603, February 1, p. 128.
The use of **arc welding** in structural engineering. (1 100 words.)

1935 **627 (.45) & 656 .213 (.45)**
Engineering, No. 3604, February 8, p. 133.
CUNNINGHAM (B.). — **Recent developments** at the **Port of Genoa.** (3 000 words & fig.)

1935 **621 .7 & 65**
Engineering, No. 3604, February 8, p. 141; No. 3606, February 22, p. 197.
The Murray **colour control system.** (5 000 words & fig.)

1935 **621 .43**
Engineering, No. 3605, February 15, p. 170.
The Haslam and Newton **hydraulic variable power transmission.** (2 300 words & fig.)

1935 **62. (01, 669 .1 & 698**
Engineering, No. 3605, February 15, p. 177; No. 3606, February 22, p. 205.
HIGHFIELD (W. E.). — **The protection of steelwork by paint.** (5 400 words.)

1935 **621 .116**
Engineering, No. 3606, February 22, p. 147.
Preheating and combustion. (2 000 words.)

1935 **621 .43**
Engineering, No. 3606, February 22, p. 155.
Air swirl in oil engines. — Paper read by Mr. J. F. ALCOCK at the Institution of Mechanical Engineers, North-Western branch. Discussion. (2 300 words.)

1935 **621 .18**
Engineering, No. 3606, February 22, p. 157.
GLINN (R. J.). — The care of modern **steam-generating plant** from the water side. Paper read before the Institution of Mechanical Engineers on the 25th January 1935. (2 300 words, tables & fig.)

1935 **624 .42**
Engineering, No. 3606, February 22, p. 158.
EVANS (R. H.) & THOMLINSON (J.). — Shear-stress distribution in **reinforced-concrete beams.** — Paper read before Section G of the British Association on September 12, 1934. (4 000 words & fig.)

1935 **385. (072 & 62. (01**
Engineering, No. 3606, February 22, p. 183.
COKER (E. G.). — **The design and equipment of photo-elastic laboratories.** (3 400 words & fig.)

1935 **62. (01 & 693**
Engineering, No. 3606, February 22, p. 188.
Compression test specimens for **cement mortars.** (800 words.)

1935 **389 & 621 .9**
Engineering, No. 3606, February 22, p. 189.
Measurement during machining and automatic sizing. (1 300 words & fig.)

1935 **656 .222.1 (.44)**
Engineering, No. 3606, February 22, p. 192.
Lord MONKSWELL. — **Locomotive work in France in 1934.** (3 400 words & fig.)

1935 **621 .43 (.42)**
Engineering, No. 3606, February 22, p. 209.
240-h.p. pneumatic-tyred **rail-car.** (800 words.)

1935 **62. (01 & 669 .1**
Engineering, No. 3606, February 22, p. 211.
DOCHERTY (J. G.). — **Slow bending tests on large notched bars.** (2 000 words & fig.)

1935 **621 .116 & 621 .18**
Engineering, No. 3606, February 22, p. 213.
SHAWCROSS (G. N.). — The care of modern **steam-generating plant** from the water side. — Paper read at the Institution of Mechanical Engineers, London, January 25. — Discussion at the Meeting of the North-Western Branch of the Institution, Manchester, January 31. (2 200 words.)

1935 **621 .33 (.45)**
Engineering, No. 3606, February 22, p. 215.
Electric traction in Italy. (800 words & fig.)

Engineering News-Record. (New York.)

1935 **624 .1 (.73**
Engineering News-Record, No. 1, January 3, p. 1.
Sinking open **cofferdams** through glacial dritt. (3 50 words & fig.)

1935 **625 .14 (.73) & 656 .222.1 (.73**
Engineering News-Record, No. 1, January 3, p. 17.
Railway **track** refinements required by higher speed (1 400 words & fig.)

1935 **624 .1 (.73) & 627 (.73**
Engineering, No. 2, January 10, p. 38.
HELEN (R. C.). — **All-welded steel ocean pier** tubular and H-piles. (1 800 words & fig.)

1935 **624 .91 & 69**
Engineering News-Record, No. 2, January 10, p. 4
BENKERT (H. N.), HANRAHAN (F. J.) & SMIT (L. W.). — **Heavy plywood sheets as gusset-pla material.** (3 200 words & fig.)

1935 **625 .7 (.73**
Engineering News-Record, No. 3, January 17, p. 6
Engineering problems of the future **highway.** symposium of special articles and discussions planne for the furtherance of efficient road developmen by Messrs R. W. Crum, M. McClintock, C. H. Purce F. T. Sheets, E. W. James, J. R. Burkey, M. V Torkelson & B. E. Gray.
1. Highway research. — 2. Traffic surveys. 3. Highway rerouting. — 4. Rational road design. 5. Road bridge design. — 6. Roadside design. 7. Secondary roads. — 8. Highway safety.

1935 **69**
Engineering News-Record, No. 4, January 24, p. 1
Concrete experimental work under desert conditio (1 900 words & fig.)

1935 **624**
Engineering News-Record, No. 4, January 24, p. 1
Bituminized concrete casing for piles in sea wat (2 200 words & fig.)

Journal, Institute of Transport. (London.)

1935 **656 .23**
Journal, Institute of Transport, January, p. 119.
HORTON (C. C.). — **Railway rates.** (7 800 word

1935 **65**
Journal, Institute of Transport, February, p. 146.
SAVILE (Sir L. H.). — **Aerodromes** for civil avi tion. (12 000 words.)

1935 **656 .222**
Journal, Institute of Transport, February, p. 162.
GREEN (W. E.). — The **time-table** in theory a practice. (4 800 words.)

Modern Transport. (London.)

1935 **621 .33 (.42) & 625 .4 (.42)**
Modern Transport, No. 827, January 19, p. 3
MACKINNON (L.). — **Electrification of Glasgow District Subway.** (5 800 words & fig.)

1935 **385 .4 & 656 .2**
Modern Transport, No. 828, January 26, p. 3.
Organisation of **railway operating.** The district officer and his staff. (3 000 words.)

1935 **347 .763 & 656**
Modern Transport, No. 829, February 2, p. 3.
PONSONBY (G. A.). — **Road transport and the State.** What is « wasteful competition » ? (2 500 words.)

1935 **621 .132.5 (.54)**
Modern Transport, No. 829, February 2, p. 4.
Metre-gauge locomotives for India. (400 words & fig.)

1935 **621 .33 (.68)**
Modern Transport, No. 829, February 2, p. 5.
Railway electrification in South Africa. (1 800 words.)

1935 **385 .1 (.47)**
Modern Transport, No. 829, February 2, p. 5.
Railway transport in U.S.S.R. — Second five-year plan. (1 000 words.)

1935 **621 .43 (.54)**
Modern Transport, No. 829, February 2, p. 9.
Oil-engined railcars on Madras & Southern Mahratta Railway. (1 200 words & fig.)

1935 **656 .1 (.42)**
Modern Transport, No. 830, February 9, p. 2.
Development of motor transport. (1 000 words.)

1935 **656 .222.1**
Modern Transport, No. 830, February 9, p. 3.
Speed in railway working. — Fast units and their possible effects. (1 700 words & fig.)

1935 **621 .139 (.42), 625 .18 (.42) & 625 .27 (.42)**
Modern Transport, No. 830, February 9, p. 5.
L. M. S. stores routine and organisation. No. 1. — Purchasing of stores. (2 400 words & fig.)

1935 **388 (.43) & 625 .4 (.43)**
Modern Transport, No. 830, February 9, p. 6.
Extension of Berlin City Railway. (1 200 words.)

1935 **656 .23 (.42)**
Modern Transport, No. 830, February 9, p. 7.
SEWELL (A. E.). — **Fixing of railway rates.** — Limited scope for agreed charges. (2 500 words.)

1935 **621 .335 (.436)**
Modern Transport, No. 830, February 9, p. 8.
STRAUSS (F.). — **Electric locomotives** in Austria. — Standard types. (650 words.)

Railway Age. (New York.)

1935 **625 .232 (.73)**
Railway Age, No. 1, January 5, p. 3.
Streamlined coaches for service on the New Haven. (2 800 words & fig.)

1935 **621 .139 (.73) & 625 .27 (.73)**
Railway Age, No. 1, January 5, p. 7.
Container methods used in handling C. & N. W. stores. (2 100 words & fig.)

1935 **385 .3 (08 (.73)**
Railway Age, No. 1, January 5, p. 13.
Interstate Commerce Commission **annual report.** (5 800 words.)

1935 **621 .43 (.73)**
Railway Age, No. 1, January 5, p. 17.
MACDONALD (G. A.). — **Diesel road locomotive** for the Midland Continental. (1 300 words & fig.)

1935 **625 .232 (.73)**
Railway Age, No. 2, January 12, p. 36.
Norfolk & Western buys de luxe **coaches.** (1 900 words & fig.)

1935 **625 .143.2 & 625 .143.3**
Railway Age, No. 2, January 12, p. 40.
MOONEY (J. R.). — Can we expect better **rails ?** (2 800 words & fig.)

1935 **625 .23 (0**
Railway Age, No. 2, January 12, p. 52.
RAGSDALE (E. J. W.). — Materials economics in **light-weight railway cars.** (2 500 words & fig.)

1935 **621 .43 (.73)**
Railway Age, No. 3, January 19, p. 70.
Norfolk Southern buys four **light rail motor cars.** (2 200 words & fig.)

1935 **656 .284 (.73)**
Railway Age, No. 3, January 19, p. 73.
Minimizing the **fire hazard in timber freight piers.** (1 100 words & fig.)

1935 **621 .132.7 (.73)**
Railway Age, No. 3, January 19, p. 79.
Nickel Plate receives five **heavy switching locomotives.** (800 words, 1 table & fig.)

1935 **385 .3 (.73) & 656 .261 (.73)**
Railway Age, No. 3, January 19, p. 82.
Pick-up and delivery service upheld. (3 000 words & fig.)

1935 **656 .1 (.73)**
Railway Age, No. 3, January 19, p. 85.
Burlington **coaches** reach the Pacific. (500 words & fig.)

1935 **621 .132.3 (.73), 625 .232 (.73) & 656 .222.1 (.73)**

Railway Age, No. 5, February 2, p. 188.

Chicago & North Western inaugurates « 400 » **high speed train service.** (3 600 words & fig.)

1935 **625 .142.2 (06 (.73) & 691 (06 (.73)**

Railway Age, No. 5, February 2, p. 193.

Wood-Preservers meet in New York. (1 500 words.)

1935 **621 .33 (.73)**

Railway Age, No. 5, February 2, p. 196.

First Washington-Philadelphia **electric train** on Pennsylvania. (1 600 words & fig.)

1935 **385 .1 (.73) & 385 .32 (.73)**

Railway Age, No. 5, February 2, p. 198.

Legislative program recommended by Co-ordinator Eastman. (14 000 words.)

1935 **621 .118 (.73), 621 .13 (.73) & 656 .286 (.73)**

Railway Age, No. 5, February 2, p. 207.

Number of **defective locomotives** continues to increase. (700 words & fig.)

1935 **621 .335 (.73) & 621 .43 (.73)**

Railway Age, No. 5, February 2, p. 220.

The « **Flying Yankee** » arrives at Boston. (6 200 words, tables & fig.)

1935 **625 .142.2 (.73) & 691 (.73)**

Railway Age, No. 5, February 2, p. 229.

CLARKE (H. R.). — Burlington demonstrates economy of **treated crossties.** (3 000 words & fig.)

1935 **385 .5 (.73)**

Railway Age, No. 5, February 2, p. 233.

Co-ordinator Eastman's **labor protection plans.** (11 500 words & 1 table.)

1935 **621 .139 (.73), 625 .18 (.73) & 625 .27 (.73)**

Railway Age, No. 6, February 9, p. 240.

Union Pacific « **streamlines** » **supply work.** 2 500 words & fig.)

1935 **656 .255 (.73)**

Railway Age, No. 6, February 9, p. 243.

Texas & New Orleans installs **centralized traffic control.** (1 300 words & fig.)

Railway Engineering and Maintenance. (New York.)

1935 **721 .5**

Railway Engineering & Maintenance, January, p. 18.

Roofs. — Practical considerations in their applications and repair. (2 400 words & fig.)

1935 **625 .143.1 (.73**

Railway Engineering & Maintenance, January, p. 2

How long rails ? Delaware & Hudson develops man interesting facts in two installations involving continuous lengths up to 2 700 ft. (3 400 words & fig.)

1935 **621 .392 (.73) & 625 .13 (.73**

Railway Engineering & Maintenance, January, p. 2

Keeping an old **viaduct** out of the scrap pile. (2 90 words & fig.)

1935 **625 .144.**

Railway Engineering & Maintenance, January, p. 3

Can track wrenches be standardized. (4 400 wor & fig.)

Railway Gazette. (London.)

1935 **656. (.71**

Railway Gazette, No. 3, January 18, p. 91.

ARTHURTON (A. W.). — **Impressions of oversea transport.** — VIII. Public transport in Toronto demonstrates the safety and efficiency to which th system can attain under progressive managemen (1 200 words.)

1935 **625 .1**

Railway Gazette, No. 3, January 18, p. 92.

HULL (Lt.-Col. H. A.). — Railway maintenanc problems, 1 — **Earthworks.** (1 600 words & fig.)

1935 **621 .138.**

Railway Gazette, No. 3, January 18, p. 96.

Optical lining-up of locomotives. (1 000 words fig.)

1935 **621 .135.2 (.42) & 621 .138.5 (.42**

Railway Gazette, No. 3, January 18, p. 98.

Progressive repair of locomotive axleboxes. — I. Details of the new system installed at the Harwic locomotive works of the L.M.S.Ry. (2 800 words & fig

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1935 **656 .25 (.45**

Railway Gazette, No. 3, January 18, p. 104.

Signalling on the Bologna-Florence Direttissim (1 600 words & fig.)

1935 **621 .43 (.45**

Railway Gazette, No. 3, January 18, p. 117.

High-speed electric and Diesel development in Ital (300 words & fig.)

1935 **625 .23 (.493) & 625 .24 (.493**

Railway Gazette, No. 4, January 25, p. 137.

New **all-steel rolling stock** in Belgium. (2 300 word & fig.)

1935 **621 .135.2 (.42) & 621 .138.5 (.42**

Railway Gazette, No. 4, January 25, p. 146.

Progressive repair of locomotive axle boxes. — II. — Details of the new system installed at th Harwich locomotive works of the L.M.S.Ry. (75 words & fig.)

1935 **621 .132.3 (.73)**
Railway Gazette, No. 4, January 25, p. 149.
New **Baldwin passenger locomotives** of the 4-8-4 type developing 69 800 lb. tractive effort. (700 words & fig.)

1935 **656 .25**
Railway Gazette, No. 4, January 25, p. 152.
A new time element relay. (350 words & fig.)

1935 **656**
Railway Gazette, No. 4, January 25, p. 157.
The world crisis and the railways. (1 600 words.)

1935 **385. (06 (.73) & 385. (091 (.∞)**
Railway Gazette, No. 5, February 1, p. 193.
ARTHURTON (A. W.). — **Impressions of overseas transport.** — X. Transport at the Chicago World's Fair, 1934. (1 200 words.)

1935 **385 .4 (.94)**
Railway Gazette, No. 5, February 1, p. 195.
Rail transport in **Australia.** (3 700 words.)

1935 **656 .222.5 (.43)**
Railway Gazette, No. 5, February 1, p. 199.
Dr.-Ing. LEIBBRAND. — Preparing **local and international timetables** in Germany. (1 diagram.)

1935 **621 .132.3 (.73)**
Railway Gazette, No. 5, February 1, p. 200.
New **high-speed locomotives,** Baltimore & Ohio RRd. (600 words & fig.)

1935 **625 .111 (.82)**
Railway Gazette, No. 5, February, 1, p. 202.
Main line widening near Maldonado Junction, Central Argentine Railway. (1 600 words & fig.)

1935 **621 .9**
Railway Gazette, No. 5, February 1, p. 207.
Some recent machine tools. Axlebox planing machine. — High-capacity rail planer. — Duplex tapping machine and automatic drilling and boring machine. (1 400 words & fig.)

1935 **385 .2 (.73) & 656 (.73)**
Railway Gazette, No. 6, February 8, p. 231.
ARTHURTON (A. W.). — **Impressions of overseas transport.** — XI. American railways and their transport competitors. Shipping enterprise by the C.P.R. at Vancouver. (1 200 words.)

1935 **621 .135.4**
Railway Gazette, No. 6, February 8, p. 232.
PORTER (the late S.R.M.). — **The mechanics of a locomotive on curved track.** — VII. (3 600 words & fig.)

1935 **621 .42 (.42) & 625 .154 (.42)**
Railway Gazette, No. 6, February 8, p. 239.
Turning locomotives by power from the brake apparatus. (700 words & fig.)

1935 **621 .133.3 (.42) & 621 .9 (.42)**
Railway Gazette, No. 6, February 8, p. 242.
Production of **steel firebox staybolts.** (350 words & fig.)

1935 **621 .134.1 (.42) & 621 .138.5 (.42)**
Railway Gazette, No. 6, February 8, p. 243.
New method of fitting **cylinder and steamchest liners.** (300 words & fig.)

1935 **656 .222.1 (.44)**
Railway Gazette, No. 6, February 8, p. 248.
Astonishing locomotive performance in France. (2 200 words.)

1935 **614, 625 .234 & 625 .4**
Railway Gazette, No. 7, February 15, p. 276.
Noise suppression on tube trains. (900 words.)

1935 **625 .143 (.73)**
Railway Gazette, No. 7, February 15, p. 278.
Long welded rails in America. (600 words.)

1935 **625 .123 & 625 .17**
Railway Gazette, No. 7, February 15, p. 284.
HULL (Lt.-Col. H. A.). — Railway maintenance problems. — II. **Drainage.** (1 000 words & fig.)

1935 **385 .4 (.42) & 656 .2 (.42)**
Railway Gazette, No. 7, February 15, p. 286.
Commercial research on the L.M.S.Ry. (2 000 words.)

1935 **621 .135.2, 621 .138.5, 625 .212 & 625 .26**
Railway Gazette, No. 7, February 15, p. 288.
ANDREW (C. D.). — **Railway wheels and axles.** (2 000 words & fig.)

1935 **621 .132.3 (.73)**
Railway Gazette, No. 7, February 15, p. 290.
Rebuilt 4-6-2 **express passenger locomotives,** Delaware and Hudson Railroad. (250 words & fig.)

1935 **656 (.54)**
Railway Gazette, No. 7, February 15, p. 296.
Transport co-ordination in India. (1 000 words.)

1935 **656 .212.6**
Railway Gazette, No. 7, February 15, p. 297.
Handling heavy loads in goods stations. — 6-ton crane mounted on a six-wheeled, oil engined Thornycroft chassis, in the service of the G.W.Ry. (1 000 words & fig.)

1935 **656 .1 (.73)**
Railway Gazette, No. 7, February 15, p. 299.
ARTHURTON (A. W.). — **Impressions of the motor coach** in America. (1 000 words & fig.)

1935 **621 .43 (.42)**
Diesel Ry. Traction, p. 167, Supplt. to the Ry. Gazette, January 25.
A new British **railway Diesel engine.** — Six-cylinder

Beardmore design developing 225 b.h.p. at 1 200 r.p.m. (400 words & fig.)

1935 **621 .43 (.56)**

Diesel Ry. Traction, p. 168, Supplt. to the Ry. Gazette, January 25.

Introduction of **Diesel traction** in the Near East (Damas-Hamah Ry.). (1 000 words & fig.)

1935 **621 .43 (.54)**

Diesel Ry. Traction, p. 170, Suppl. to the Ry. Gazette, January 25.

Welded steel Diesel railcars for India. (800 words & fig.)

1935 **621 .43 (.43)**

Diesel Ry. Traction, p. 172, Supplt. to the Ry. Gazette, January 25.

Berlin Local Railway adopts Diesels. (800 words & fig.)

1935 **621 .43 (.493)**

Diesel Ry. Traction, p. 174, Supplt. to the Ry. Gazette, January 25.

100 **Diesel** railcars for Belgium. (600 words & fig.)

1935 **621 .43**

Diesel Ry. Traction, p. 176, Supplt. to the Ry. Gazette, January 25.

Mechanical transmission with electric control. — The Cotal gearbox. (600 words & fig.)

1935 **621 .43**

Diesel Ry. Traction, p. 177, Supplt. to the Ry. Gazette, January 25.

BASSETT (H. N.). — **Diesel fuels and their selection.** (3 800 words & fig.)

1935 **621 .33 (.42)**

Electric Ry. Traction, p. 263, Supplt. to the Ry. Gazette, February 8.

Electrification of the Sevenoaks lines, Southern Railway, England. (3 000 words & fig.)

Railway Magazine. (London.)

1935

Railway Magazine, February, p. 87.

ALLEN (C. J.). — **British locomotive practice and performance.** (4 500 words, tables & fig.)

1935 **385 (091 (.44)**

Railway Magazine, February, p. 121.

The metamorphosis of the French State Railways. (4 000 words, tables & fig.)

Railway Mechanical Engineer. (New York.)

1935 **621 .132.3 (.73) & 621 .132.5 (.73)**

Railway Mechanical Engineer, January, p. 1.

General purpose **4-8-4 type locomotives** for Delaware, Lackawanna & Western. (1 600 words & fig.)

1935 **621 .13, 621 .335 & 621 .**

Railway Mechanical Engineer, January, p. 5.

WRIGHT (G. I.) & McGEE (P. A.). — **Motive pow requirements for high-speed trains.** Part. II. (2 words, tables & fig.)

1935 **656 .**

Railway Mechanical Engineer, January, p. 9.

Some things that must be done to build up freig traffic. (1 100 words.)

1935 **625 .245 (.7**

Railway Mechanical Engineer, January, p. 11.

Bessemer orders hoppers of Pressed Steel Compan design. (1 900 words & fig.)

1935 **625 .2**

Railway Mechanical Engineer, January, p. 14.

GRAY (W. E.). — Determining **car-wheel eccent city.** (2 400 words, tables & fig.)

1935 **625 .2 (0 & 669**

Railway Mechanical Engineer, January, p. 17.

CHARLTON (E. J.). — **Welded Cromansil structu in** railway services. (2 300 words & fig.)

1935 **625 .13 (0 & 656 .22**

Railway Mechanical Engineer, January, p. 23.

Streamlining. (1 100 words.)

Railway Signaling. (Chicago.)

1935 **313 : 656 .25 (.71 + .7**

Railway Signaling, January, p. 17.

Signaling construction hits new low in 1934. (2 9 words & fig.)

1935 **656 .256 (.73) & 656 .258 (.7**

Railway Signaling, January, p. 25.

ROBERTS (A. A.). — **Automatic interlocking** on t Brooklyn-Manhattan Transit. (3 000 words & fig.)

1935 **625 .162 (.73) & 656 .259 (.7**

Railway Signaling, January, p. 28.

Traffic-type crossing signals on the Texas & N Orleans. (2 300 words.)

1935 **625 .162 (.73) & 656 .259 (.7**

Railway Signaling, January, p. 31.

Crossing signals on the Chicago & North Western Oshkosh, Wis. (1 500 words & fig.)

1935 **656 .256.3 (.73) & 656 .258 (.7**

Railway Signaling, January, p. 33.

Automatic interlocking on the Wabash. (1 800 wor & fig.)

South African Railways and Harbours Magazine. (Johannesburg.)

1935 **621 .132.5 (.68)**

South African Rys. & Harbours Magazine, January, p. 3.

New engines for the South African Railways. Class 19 C locomotives. (900 words & fig.)

The Locomotive. (London.)

1935 **621 .132.3 (.438)**

The Locomotive, No. 509, January 15, p. 4.

2-10-2 passenger tank locomotive, Polish State Rys. (1 000 words & fig.)

1935 **621 .43 (.42)**

The Locomotive, No. 509, January 15, p. 7.

Harland & Wolff **Diesel locomotive for** L. M. & S. Ry. (500 words & fig.)

1935 **625 .253 (.47)**

The Locomotive, No. 509, January 15, p. 14.

Two Russian **air brakes.** (1 900 words & fig.)

1935 **621 .136.2**

The Locomotive, No. 509, January 15, p. 26.

The « Goodall » patent **articulated drawbar and coupling.** (950 words & fig.)

1935 **621 .135.2 (.54)**

The Locomotive, No. 509, January 15, p. 28.

Roller bearings applied to locomotive leading bogie. (300 words & fig.)

In Spanish.

Caminos de hierro. (Madrid.)

1935 **385**

Caminos de hierro, enero, p. 8.

MONREAL (M.) & CASTILLO (M.). — La **crisis ferroviaria** y sus posibles remedios. (700 palabras.) (Continuará.)

Ferrocarriles y Tranvias. (Madrid.)

1935 **656 .23 (0**

Ferrocarriles y Tranvias, enero, p. 2.

ALFONSO (E.). — La complejidad de la **tarificación.** (3 000 palabras.)

1935 **656 .25**

Ferrocarriles y Tranvias, enero, p. 6.

GARCIA REYES (C.). — **Señales para protección y control de anormalidad de itinerario.** (2 400 palabras & fig.)

Ingenieria y Construcción. (Madrid.)

1935 **624 (.3)**

Ingenieria y Construcción, febrero, p. 78.

CASADO (C. F.). — Las **estructuras** durante 1934. (3 000 palabras & fig.)

Revista de Ingenieria Industrial. (Madrid.)

1935 **621 .135.3 & 625 .213**

Revista de Ingenieria industrial, enero, p. 2.

LAFFITTE (C.). — El funcionamiento de la **suspensión de vehículos.** (6 800 palabras & fig.)

Revista de Obras Públicas. (Madrid.)

1935 **624 .6**

Revista de Obras Públicas, nº 4, 15 de febrero, p. 64.

CASADO (C. F.). — **Teoría del arco.** (1 100 palabras, 6 tablas & fig.)

1935 **624 .63 (.460)**

Revista de Obras Públicas, nº 4, 15 de febrero, p. 70.

VILLALBA GRANADA (C.). — **Puente** de 538 metros de longitud sobre el río Guadiana, en Lobón (Badajoz). (3 000 palabras & fig.)

In Italian.

La tecnica professionale. (Firenze.)

1935 **621 .133.7**

La tecnica professionale, febbraio, p. 33.

MENGHI (S.). — Le prove di collaudo e di controllo degli apparecchi di **alimentazione di acque in caldaia.** — Parte II. Preriscaldatori tipo « Knorr ». (4 200 parole & fig.)

1935 **625 .245**

La tecnica professionale, febbraio, p. 42.

PEDEMONTI. — **Carro speciale** a piano ribassato per il trasporto di colli molto pesanti portata 100 tonn. (800 parole & fig.)

1935 **621 .333**

La tecnica professionale, marzo, p. 68.

DI MAJO. — I principi teorici dell' avviamento e della regolazione di velocità nei **motori a corrente continua.** (3 300 parole & fig.)

1935 **651**

La tecnica professionale, marzo, p. 76.

La **meccanizzazione nelle contabilità** delle officine di grande riparazione. (1 600 parole & fig.)

L'Ingegnere. (Roma.)

1935 **693**

L'Ingegnere, nº 2, 16 gennaio, p. 68.

UMILTA (M.). — **Cementi ed agglomeranti cementizi.** (500 parole.)

1935 **656 (.45)**

L'Ingegnere, nº 4, 16 febbraio, p. 130.

NISSIM (R.). — **La questione dei trasporti terrestri.** (4 500 parole.)

Rivista tecnica delle ferrovie italiane. (Roma.)

1935 **625 .244 (.45)**

Rivista tecnica delle ferrovie italiane, 15 gennaio, p. 1.

FORTE (G.). — **Esperienze pratiche di trasporti ortofrutticoli.** (3 300 parole & fig.)

1935 **62. (01**

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1935 **62. (01**
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1935 **625 .12 & 62**
Engineering News-Record, No. 10, March 7, p. 346.
TRACY (E. L.). — Jacking 5-ft. **concrete pipe** und railway fills. (2 700 words, tables and fig.)

1935 **624. (**
Engineering News-Record, No. 10, March 7, p. 354.
JORDAN (A. F.). — Details of design that influen **steel bridge** economy. (1 500 words.)

Journal, Permanent Way Institution. (Woking.)

1934 **625 .142.2 & 69**
Journal, Perm. Way Institution, Part III, Decemb p. 270.
BOWLER (F. T.). — Creosoting of **sleepers.** (3 2 words and fig.)

1934 **656 .25 (**
Journal, Perm. Way Institution, Part III, Decemb p. 279.
A survey of some **signalling principles.** (5 200 wor and fig.)

1934 **654 & 656 .284**
Journal, Perm. Way Institution, Part III, December, p. 293.
DYKE (A. W. M.). — **Snowstorms and railway telegraphs.** (5 000 words and fig.)

1934 **389 & 625 .14**
Journal, Perm. Way Institution, Part III, December, p. 306.
THOMAS (T. J.). — **Measuring up quantities in track work.** (4 000 words.)

1935 **625 .144.4 (.62)**
Journal, Perm. Way Institution, Part III, December, p. 316.
CATES (F. G.). — **Track tools in Sudan** (1 700 words and fig.)

Railway Age. (New York.)

1935 **385 .113 (.73)**
Railway Age, No. 4, January 26, p. 101.
PARMELEE (Dr. J. H.). — **A review of railway operations in 1934.** (8 200 words and tables.)

1935 **656 .222.1 (.73)**
Railway Age, No. 4, January 26, p. 108.
DOSTER (R. A.) & LAYNG (CH.). — **Speed an outstanding development in 1934.** (3 900 words and fig.)

1935 **385. (061.4**
Railway Age, No. 4, January 26, p. 113.
LANE (H. F.). — **Association of American Railroads.** — Progress being made in organizing the mani-fold activities of new set-up (1 200 words and fig.)

1934 **347 .763 (.73) & 385 .3 (.73)**
Railway Age, No. 4, January 26, p. 120.
LANE (H. F.). — The outlook for transportation legislation. — **Co-ordinated regulation of competing carriers appears probable.** (3 600 words.)

1934 **385 .1 (.71) & 385 .4 (.71)**
Railway Age, No. 4, January 26, p. 123.
LYNE (J. G.). — **Amalgamation issue pushed to fore in Canada.** (2 800 words.)

1934 **385 .113 (.72)**
Railway Age, No. 4, January 26, p. 126.
PROCEL (N.). — **Mexican Railways returning to prosperity.** (2 000 words and fig.)

1935 **385 .1 (.71)**
Railway Age, No. 4, January 26, p. 129.
LYNE (J. G.). — **Narrow market movement marks financial doldrums of 1934.** (2 000 words and 9 tables.)

1935 **313 : 625 .1 (.71 + .73)**
Railway Age, No. 4, January 26, p. 136.
BOYD (G. E.). — **Railway construction at low ebb.** (1 900 words, tables and fig.)

1935 **313 : 621 .139 (.73), 313 : 625 .18 (.73) & 313 : 625 .27 (.73)**
Railway Age, No. 4, January 26, p. 142.
STEEL (D. A.). — **Cost of railway material higher in 1934.** (4 400 words, tables and fig.)

1935 **313 : 621 .13 (.71 + .73)**
Railway Age, No. 4, January 26, p. 155.
TAFT (W. J.). — **Locomotives ordered in 1934.** (1 000 words and tables.)

1935 **313 : 625 .24 (.71 + .73)**
Railway Age, No. 4, January 26, p. 158.
KRAEGER (F. W.). — **Freight cars ordered in 1934.** (900 words and tables.)

1935 **313 : 625 .23 (.71 + .73)**
Railway Age, No. 4, January 26, p. 161.
KRAEGER (F. W.). — **Passenger car orders in 1934.** (900 words and tables.)

1935 **621 .43 (.73)**
Railway Age, No. 4, January 26, p. 163.
PECK (C. B.). — **More articulated motor trains ordered than in 1933.** (900 words and tables.)

1935 **313 : 656 .254 (.71 + .73)**
Railway Age, No. 4, January 26, p. 164.
FRENCH (O. C.). — **Communication service helds its own.** (1 500 words.)

1935 **656 (.73)**
Railway Age, No. 4, January 26, p. 167.
LAYNG (CH.). — **Rail-highway co-ordination no longer experimental.** (1 800 words and 1 table.)

1935 **656 .224 (.73) & 656 .231 (.73)**
Railway Age, No. 4, January 26, p. 170.
Modernization of passenger service recommended. (5 400 words and fig.)

1935 **624. (0 (.73)**
Railway Age, No. 7, February 16, p. 262.
Use light weight ballast floor on bridge designed for open deck. (3 000 words and fig.)

1935 **621 .132.3 (.73) & 621 .132.5 (.73)**
Railway Age, No. 7, February 16, p. 267.
Lackawanna receives twenty more **4-8-4 type locomotives.** (1 700 words, 2 tables and fig.)

1935 **625 .162 (.73) & 656 .259 (.73)**
Railway Age, No. 7, February 16, p. 271.
Automatic crossing gates on the Illinois Central. (1 800 words and fig.)

1935 **625 .13 (.73) & 693 (.73)**
Railway Age, No. 8, February 23, p. 290.
Excellent plant expedites **tunnel lining** on Illinois Central. (2 600 words and fig.)

1935 **621 .132.3 (.73) & 621 .132.5 (.73)**

Railway Age, No. 8, February 23, p. 293.

Lehigh Valley acquires five more **4-8-4 type locomotives.** (1 900 words and fig.)

1935 **625 .233**

Railway Age, No. 8, February 23, p. 295.

HELMBRIGHT (H. H.) & LEE (F. B.). — What is the best way to light **passengers cars.** (1 200 words and fig.)

1935 **621 .116 (.73)**

Railway Age, No. 8, February 23, p. 297.

Smokeless combustion of powdered coal. — New Haven disposes of smoke electrically at its Cos Cob, Conn., power plant. (800 words and fig.)

1935 **621 .139, 625 .18 & 625 .27**

Railway Age, No. 8, February 23, p. 303.

HALL (U. K.). — Progress and problems of **purchasing and stores departments.** (4 400 words.)

1935 **621 .43**

Railway Age, No. 8, February 23, p. 306.

Highway equipment on rails. — Cotton Belt transforms motor coaches into **rail cars** with excellent results. (1 200 words and fig.)

Railway Engineering and Maintenance. (Chicago.)

1935 **625 .142.2 (.73) & 691 (.73)**

Railway Engineering and Maintenance, February, p. 76.

CLARKE (H. R.). — Saving a million **crossties** a year. (3 200 words and fig.)

1935 **624. (0 (.73) & 691 (.73)**

Railway Engineering and Maintenance, February, p. 79.

REAR (G. W.). — Sixty years experience with **treated timber.** (3 100 words and fig.)

1935 **721 .5 (.73)**

Railway Engineering and Maintenance, February, p. 82.

ROOFS. — **Asbestos shingles** — how to apply them. (1 800 words and fig.)

1935 **625 .123 (.73)**

Railway Engineering and Maintenance, February, p. 84.

Drying up incessantly **wet tracks.** (4 600 words and fig.)

1935 **691**

Railway Engineering and Maintenance, February, p. 89.

Treating **timber** better. (1 600 words and fig.)

1935 **625 .17 (.73)**

Railway Engineering and Maintenance, March, p. 144.

How far behind in **maintenance of way.** (2 700 words and fig.)

1935 **625 .144.4**

Railway Engineering and Maintenance, March, p. 147.

Obsolescence in **work equipment.** — Is it getting adequate consideration ? (4 100 words and fig.)

1935 **625 .144.4 (.73)**

Railway Engineering and Maintenance, March, p. 156.

Is the **hand tool** passing ? (2 500 words and fig.)

1935 **625 .144.4 (.73)**

Railway Engineering and Maintenance, March, p. 159.

Safe-guarding work equipment. (3 400 words, 1 table and fig.)

Railway Gazette. (London.)

1935 **625 .234 (.73)**

Railway Gazette, No. 8, February 22, p. 328.

ARTHURTON (A. W.). — Impressions of overseas transport. — XII. — What **air-conditioning** means in terms of comfort and equipment. (1 500 words.)

1935 **625 .172 (.42)**

Railway Gazette, No. 8, February 22, p. 329.

Systematic maintenance of **permanent way.** (1 700 words and 2 tables.)

1935 **621 .132.3 (.68)**

Railway Gazette, No. 8, February 22, p. 331.

South African **4-8-2 type locomotives.** (300 words and fig.)

1935 **621 .134.3**

Railway Gazette, No. 8, February 22, p. 332.

New French superheaters. (700 words, 1 table and fig.)

1935 **621 .132.3 (.44)**

Railway Gazette, No. 8, February 22, p. 334.

Increasing the **efficiency of express locomotives,** Eastern Railway of France. (1 200 words, 1 table and fig.)

1935 **621 .134.3 (.42)**

Railway Gazette, No. 8, February 22, p. 337.

Manufacture of **superheater units.** (500 words and fig.)

1935 **621 .43 (.44)**

Railway Gazette, No. 8, February 22, p. 340.

Pneumatic-tyred railcar on the L. M. S. Ry. (750 words and fig.)

1935 **656 .222.1 (.44)**

Railway Gazette, No. 8, February 22, p. 346.

Astonishing **locomotive performance** in France. (3 000 words.)

1935 **621 .13 & 656 .222.1**

Railway Gazette, No. 9, March 1, p. 385.

High speed and the steam locomotive. (2 500 words.)

1935 **621 .132.3 (.43)**
Railway Gazette, No. 9, March 1, p. 387.
New **high speed steam locomotive** designs in Germany. (4 200 words and fig.)

1935 **621 .94 & 625 .212**
Railway Gazette, No. 9, March 1, p. 393.
ANDREW (C. D.). — **Railway wheels and axles.** — II. — Wheel lathe design and some suggested improvements. (2 500 words and fig.)

1935 **625 .13 (.42)**
Railway Gazette, No. 9, March 1, p. 397.
Widening a tunnel on the Southern Ry. (1 000 words and fig.)

1935 **385. (08 (.42)**
Railway Gazette, No. 9, March 1, p. 402.
The **annual general meeting** of the Great Western Railway Company. (12 000 words.)

1935 **656 .283 (.42)**
Railway Gazette, No. 9, March 1, p. 412.
Ministry of transport **accident reports :** between Formby and Freshfield, L.M.S.Ry., Oct. 2, 1934; Wormley, between Broxbourne and Cheshunt, L. N. E. Ry., November 27, 1934. (850 words and fig.)

1935 **621 .135.4**
Railway Gazette, No. 10, March 8, p. 432.
PORTER (the late S. R. M.). — The **mechanics** of a locomotive on **curved track.** — VIII. (3 800 words and fig.)

1935 **621 .392 & 621 .138.5**
Railway Gazette, No. 10, March 8, p. 435.
BRETT (C. W.). — The **application** of **welding** to railway work. (1 000 words and fig.)

1935 **385. (091 (.64)**
Railway Gazette, No. 10, March 8, p. 439.
The **railway system** of Morocco. (2 700 words and fig.)

1935 **621 .132.5 (.85)**
Railway Gazette, No. 10, March 8, p. 443.
New locomotives for the Central Railway of Peru. — A 2-8-0 type designed for passengeer service. (1 300 words and fig.)

1935 **385 (08 (.42)**
Railway Gazette, No. 10, March 8, p. 450.
The **annual general meeting** of the Southern Railway Company. (7 000 words.)

1935 **385 (08 (.42)**
Railway Gazette, No. 10, March 8, p. 455.
The **twelfth annual general meeting** of the London Midland and Scottish Railway. (12 000 words.)

1935 **625 .17**
Railway Gazette, No. 11, March 15, p. 499.
HULL (Lt. Col. H. A.). — **Railway maintenance** problems. — III. — **Foundations.** (1 500 words and fig.)

1935 **621 .132.8 (.61)**
Railway Gazette, No. 11, March 15, p. 500.
More **express passenger Beyer-Garratts** for Algeria. (700 words.)

1935 **656 .222.1 (.42)**
Railway Gazette, No. 11, March 15, p. 501.
Further details of the L. N. E. Ry. **record run.** (1 700 words and fig.)

1935 **656 .1 (.42)**
Railway Gazette, No. 11, March 15, p. 503.
Railway shareholdings in road transport. (900 words, 1 table and 1 map.)

1935 **621 .132.3 (.42)**
Railway Gazette, No. 11, March 15, p. 509.
The locomotive that holds world **speed records.** (650 words and fig.)

1935 **621 .134.1 (.42) & 621 .138.5 (.42)**
Railway Gazette, No. 11, March 15, p. 511.
THOM (R. A.). — **Built-up axles** for modern express locomotives. (2 100 words and fig.)

1935 **385 (08 (.42)**
Railway Gazette, No. 11, March 15, p. 522.
The **twelfth ordinary general meeting** of the London and North Eastern Ry. (10 000 words.)

1935 **621 .43 (.460)**
Diesel Ry. Traction, p. 358, Supplt. to the Ry. Gazette, February 22.
Diesel traction development in Spain. (1 500 words and fig.)

1935 **621 .43 (.54)**
Diesel Ry. Traction, p. 362, Supplt. to the Ry. Gazette, February 22.
Madras and Southern Mahratta **railcars.** (800 words and fig.)

1935 **621 .43 (.436)**
Diesel Ry. Traction, p. 366, Supplt. to the Ry. Gazette, February 22.
KAAN (E. R.).— New **Diesel** railcars and locomotives in Austria. (800 words and fig.)

1935 **621 .43 (.494)**
Diesel Ry. Traction, p. 368, Supplt. to the Ry. Gazette, February 22.
Diesel railcars on Swiss private railway. (500 words and fig.)

1935 **621 .43 (.492)**
Diesel Ry. Traction, p. 369, Supplt. to the Ry. Gazette, February 22.
The Dutch **Diesel train failures.** (3 200 words and fig.)

1935 **621 .43**
Diesel Ry. Traction, p. 372, Supplt. to the Ry. Gazette, February 22.
Direct-drive Diesel locomotives for high speeds. (750 words and fig.)

1935 621 .33
Electric Ry. Traction, p. 477, Supplt. to the Ry. Gazette, March 8.
British railway electrification. — Views of railway chairmen. (1 400 words.)

1935 385 .113 (.54) & 621 .33 (.54)
Electric Ry. Traction, p. 479, Supplt. to the Ry. Gazette, March 8.
Indian railway electrification results. (1 000 words and fig.)

1935 621 .33 (.82)
Electric Ry. Traction, p. 480, Supplt. to the Ry. Gazette, March 8.
Central Argentine **Railway electrification.** (2 000 words, tables and fig.)

1935 621 .338 (.494)
Electric Ry. Traction, p. 484, Supplt. to the Ry. Gazette, March 8.
Swiss Federal **electric motor-coaches.** (150 words and fig.)

1935 621 .336 (.489)
Electric Ry. Traction, p. 485, Supplt. to the Ry. Gazette, March 8.
Lubrication of overhead wires. (500 words.)

1935 621 .332
Electric Ry. Traction, p. 486, Supplt. to the Ry. Gazette, March 8.
CROFT (E. H.). — **Auxiliary power for electric traction equipments.** (2 800 words and fig.)

Railway Mechanical Engineer. (New York.)

1935 625 .232 (.73)
Railway Mechanical Engineer, February, p. 43.
New Haven **streamline** coaches placed in service. (3 400 words and fig.)

1935 621 .132.3 (.42)
Railway Mechanical Engineer, February, p. 48.
2-8-2 type express locomotive for L. N. E. Ry. (2 400 words, 1 table and fig.)

1935 621 .132.3 (.73), 625 .232 (.73) & 656 .222.1 (.73)
Railway Mechanical Engineer, February, p. 52.
North Western « 400 » **high speed train.** (2 200 words, 1 table and fig.)

1935 621 .118 (.73) & 656 .28 (01 (.73)
Railway Mechanical Engineer, February, p. 54.
Annual report of the Bureau of Locomotive Inspection. (1 000 words and fig.)

1935 621 .133.7 (.73)
Railway Mechanical Engineer, February, p. 56.
Locomotive water conditioner improved. (800 words and fig.)

1935 389 & 621 .13 (
Railway Mechanical Engineer, February, p. 58.
Sectional scales for weighing locomotives. (1 60
words.)

1935 621 .133.
Railway Mechanical Engineer, February, p. 59.
Reid steam-pipe casing. (500 words and fig.)

1935 621 .138.5 & 621 .4
Railway Mechanical Engineer, February, p. 75.
MOOR (H. H.). — The maintenance of Diesel engi
cylinders. (1 000 words and fig.)

Railway Signaling. (Chicago.)

1935 625 .162 (.73) & 656 .259 (.73
Railway Signaling, February, p. 67.
Selective speed control for **crossing signals.** (1 8
words and fig.)

1935 621 .85 (.73) & 656 .25 (0 (.73
Railway Signaling, February, p. 70.
Signal repair shop equipment on the Northern Pa
fic. (1 900 words and fig.)

1935 656 .25
Railway Signaling, February, p. 73.
PARKINSON (J. A.). — The use of modern D.
relays on **track circuits.** (1 900 words, 7 tables a
fig.)

1935 62. (01 & 656 .25 (
Railway Signaling, February, p. 77.
KOLB (E. W.). — **X-rays in the signal industr**
(3 100 words and fig.)

1935 621 .39 & 656 .2
Railway Signaling, February, p. 81.
NOBLE (S. E.). — **Capacitors** used on Chicago a
North Western. — Power-factor improved from
to 87 per cent on 440-volt single-phase line used f
feeding a train-control territory. (1 800 words a
fig.)

1935 656 .258 (.73
Railway Signaling, February, p. 84.
New **interlocking** in the Chicago loop. (2 000 wor
and fig.)

1935 656 .257 (.73
Railway Signaling, February, p. 87.
Switch-stand selector. (1 200 words and fig.)

Mechanical Engineering. (New York.)

1935 669 .
Mechanical Engineering, February, p. 79.
JOHNSTON (J.). — Applications of science to t
making and finishing of steel. (5 800 words and fig

1935 613 & 614

[M]echanical Engineering, February, p. 95.

STRATTON (R. C.). — **Toxic dusts.** — Their origin [a]nd sources in various industries. (4 200 words and [f]ig.)

1935 621

[M]echanical Engineering, February, p. 99.

HIRSCHFELD (C. F.). — **Progress in power.** (2 900 [w]ords.)

1935 697

[M]echanical Engineering, February, p. 103.

DREWRY (M. K.). — The application of central-[s]tation practice to **domestic heating.** (4 300 words and tables.)

Modern Transport. (London.)

1935 614, 625 .234 & 625 .4

[M]odern Transport, No. 831, February 16, p. 3.

Noise reduction on London Underground Railways. (1 300 words and fig.)

1935 656 .25 (0

[M]odern Transport, No. 831, February 16, p. 4.

MORGAN (H. E.). — Outlook for **railway signalling.** [N]eed for research and standardisation. (1 600 words.)

1935 621 .139 (.42), 625 .18 (.42) & 625 .27 (.42)

[M]odern Transport, No. 831, February 16, p. 5.

L. M. S. Ry. stores routine and organisation. — [N]o. 2. — **Standardisation of materials.** (1 900 words [a]nd 1 chart.)

1935 625 .162 & 656 .286

[M]odern Transport, No. 831, February 16, p. 7.

Safeguarding **level crossings.** (1 900 words.)

1935 621 .13, 621 .33 & 621 .43

[M]odern Transport, No. 831, February 16, p. 8.

Future of railway traction. — Views of proeminent [F]renchman. (1 000 words.)

1935 656 .212 (.42)

[M]odern Transport, No. 831, February 16, p. 9.

FALCONER (E.). — Scientific research in **goods [t]erminal** operation. (4 200 words and fig.)

1935 625 .4 (.42)

[M]odern Transport, No. 832, February 23, p. 3.

New **tube** railway for London. (1 800 words and [fi]g.)

1935 621 .43 (.42)

[M]odern Transport, No. 832, February 23, p. 5.

High-speed railcars on L. M. S. Ry. — Trials with [th]e « Coventry Pneumatic ». (2 400 words and fig.)

1935 656 .237.2 (.42)

Modern Transport, No. 832, February 23, p. 7.

LANCASTER (H. H.). — **Efficiency** in **passenger transport operation.** (1 500 words.)

1935 385 .59

Modern Transport, No. 832, February 23, p. 9.

Staff co-operation in the transport industry. — Value of conciliation. (1 600 words.)

1935 621 .33 (.42) & 625 .13 (.42)

Modern Transport, No. 833, March 2, p. 3.

Further Southern Railway **electrification.** (3 200 words and fig.)

1935 625 .4 (.52)

Modern Transport, No. 833, March 2, p. 5.

Underground railway of Tokyo built to withstand **earthquakes.** (1 400 words and fig.)

1935 621 .13 & 656 .222.1

Modern Transport, No. 833, March 2, p. 6.

Locomotive design. — **Building for fast traffic.** Extract from a paper read by Dr. Ing. Ch. R. P. Wagner, before the Institution of Locomotive Engineers, London, February 28, 1935. (1 200 words.)

1935 656 .222.1 (.73)

Modern Transport, No. 833, March 2, p. 6.

High-speed railways. — Developments in U. S. A. (1 200 words.)

1935 656 .212.6 (.42)

Modern Transport, No. 833, March 2, p. 9.

A six-wheel mobile **crane.** — New unit for G. W. R. (1 000 words and fig.)

1935 656 .222.1 (.42)

Modern Transport, No. 834, March 9, p. 3.

L. N. E. Ry. breaks further **speed records.** (1 600 words.)

1935 621 .132 (.42)

Modern Transport, No. 834, March 9, p. 4.

New L. M. S. **tank engines.** — Superheated 2-6-2 type units. (1 000 words and fig.)

1935 621 .335 (.82) & 621 .43 (.82)

Modern Transport, No. 834, March 9, p. 5.

Diesel-electric trains in Argentina. (2 000 words and fig.)

1935 621 .33 (.42)

Modern Transport, No. 834, March 9, p. 6.

Home railways and electrification. — Chairmen's statements. (1 000 words.)

1935 656 .1 (.42) & 656 .261 (.42)

Modern Transport, No. 834, March 9, p. 7.

HARRISON (A. A.). — **Railway road motor services.** — Developments on the L. N. E. Ry. (1 350 words and fig.)

1935 **624 .32 (.67)**

Modern Transport, No. 834, March, 9, Lower Zambesi bridge section, p. III.

Completion of the **longest railway bridge in the world.** — British engineers build 12 064-ft. structure over the Lower Zambesi River. (5 900 words and fig.)

1935 **625 .1 (.67)**

Modern Transport, No. 834, March, 9, Lower Zambesi bridge section, p. VII.

The Lower Zambesi bridge and its connecting railway. — Consolidation of the Central Africa systems. (1 400 words and fig.)

1935 **624 .32 (.67)**

Modern Transport, No. 834, March, 9, Lower Zambesi bridge section, p. IX.

Preliminaries to a great undertaking. — Sidelights on the constructional problems of the Lower Zambesi bridge. (2 500 words and fig.)

1935 **624 .32 (.67)**

Modern Transport, No. 834, March, 9, Lower Zambesi bridge section, p. XV.

Constructional features of Lower Zambesi bridge. (5 400 words and fig.)

1935 **656 .212**

Modern Transport, No. 835, March 16, p. 3.

Centralisation of railway **goods terminal work.** (4 000 words and fig.)

1935 **656 .222 & 656 .225**

Modern Transport, No. 835, March 16, p. 7.

Traffic working in fog. (2 000 words.)

1935 **621 .132.3 (.43) & 656 .221 (.43)**

Modern Transport, No. 835, March 16, p. 9.

Further developments in **streamlined steam locomotives.** A totally enclosed 4-6-4 three-cylinder unit produced at the Borsig works. (2 300 words and fig.)

1935 **621 .89**

Modern Transport, No. 835, March 16, p. 10.

Colloidal graphite use as an adjunct lubricant. (1 200 words.)

1935 **621 .43 (.42)**

Modern Transport, No. 835, March 16, p. 11.

Transmission for Diesel rail traction. The Armstrong Whitworth system. (1 200 words and fig.)

1935 **621 .43 (.47)**

Modern Transport, No. 835, March 16, p. 12.

Diesel engine tests in U. S. S. R. — International competition. (800 words.)

1935 **656 (.72)**

Modern Transport, No. 835, March 16, p. 13.

Transport in Latin America. (2 400 words.)

Proceedings, Institution of Civil Engineers. (London.)

1933-1934 **656 .1 (.42**

Proceed., Institut. of Civil Engineers, Part I, p. 2.

Address of Sir Henry P. Maybury, President. (9 00 words.)

1933-1934 **625 .7 & 656 .**

Proceed., Institut. of Civil Engineers, Part I, p. 27.

AUGHTIE (F.), BATSON (R. G. C.) & BROWN (J. F. C.). — **Impact of wheels on roads.** (24 000 word tables and fig.) (Paper, correspondence and discu sion.)

1933-1934 **625 .13 (.54**

Proceed., Institut. of Civil Engineers, Part I, p. 108.

WATSON (J. D.). — The **reconstruction** of t **Empress bridge** over the River Sutlej on the Nort Western Railway, India. (23 800 words and fig (Paper, correspondence and discussion.)

1933-1934 **621 .4**

Proceed., Institut. of Civil Engineers, Part I, p. 163.

DAVID (W. Th.). — The working fluid of interna **combustion engines.** (1 700 words and fig.) (Pape correspondence and discussion.)

1933-1934 **656 .212**

Proceed., Institut. of Civil Engineers, Part I, p. 210.

BENTHAM (C.). — **Equipment for handling pho phate rock** at Nauru and Ocean Island. (12 500 wor and fig.) (Paper, correspondence and discussion.)

1933-1934 **624. (0 & 624**

Proceed., Institut. of Civil Engineers, Part I, p. 239.

FOXLEE (R. W.). — **Hammer-blow impact** on t main girders of railway bridges. (19 000 words, tabl and fig.) (Paper, correspondence and discussion.)

1933-1934 **624. (0 & 624**

Proceed., Institut of Civil Engineers, Part I, p. 314.

GELSON (W. E.). — **Moving-load stresses** in shor span railway-bridges. (38 000 words and fig.) (Pape correspondence and discussion.)

1933-1934 **385. (01, 656 .1 & 656**

Proceed., Institut. of Civil Engineers, Part I, p. 546.

SPILLER (J. W.). — **The respective merits of roa and railways for colonial development.** (40 000 wor and tables.) (Paper, correspondence and discussion

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1933-1934 **691 & 7**

Proceed., Institut of Civil Engineers, Part I, p. 639.

BOOTH (J. J.). — The design of an **earthquake-r sisting structure** : the Dominion Museum, Wellingto N. Z. (1 000 words and fig.)

The Locomotive. (London.)

1935 **656 .2**

The Locomotive, February 15, p. 31.

Long runs. (1 200 words.)

1935 **625 .25**

The Locomotive, February 15, p. 44.

Brakes for stream-lined vehicles. — Paper presented at the meeting of the Institution of Locomotive Engineers, January 31, 1935. (1 400 words.)

1935 **656 .25 (.47)**

The Locomotive, February 15, p. 47.

Two Russian air brakes. (3 500 words.) (To be continued.)

1935 **621 .132.3 (.73)**

The Locomotive, February 15, p. 55.

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1935 **621 .43 & 625 .2**
Elektrische Bahnen, Februar, S. 53.
Einfluss der Form der Wagenenden auf den Luftwiderstand und auf die Zugförderkosten bei hohen Geschwindigkeiten. (1 200 Wörter & Abb.)

1935 **621 .335**
Elektrische Bahnen, Heft 3, März, S. 57.
KLEINOW (W.). — Zugkraft und Leistung **elektrischer Lokomotiven.** (3 400 Wörter & Abb.)

1935 **621 .333**
Elektrische Bahnen, Heft 3, März, S. 61.
SCHÖN (L.). — Die **Motoren** der Kruppschen Höllentalbahn-Lokomotive. (4 400 Wörter & Abb.)

1935 **621 .332**
Elektrische Bahnen, Heft), März, S. 68.
KETTLER. — **Fahrleitung** mit drehbaren Rohrauslegern und nachgespanntem Tragseil für hohe Geschwindigkeiten. (7 000 Wörter, 2 Tafeln & Abb.)

Glasers Annalen. (Berlin.)

1935 **385 (.43)**
Glasers Annalen, Heft 5, 1. März, S. 35.
LINDERMAYER. — Die **nationale Rohstoffwirtschaft** und die Deutsche Reichsbahn. (7 500 Wörter & Abb.)

1935 **385 (.43)**
Glasers Annalen, Heft 6, 15. März, S. 43.
LINDERMAYER. — Die **nationale Rohstoffwirtschaft** und die Deutsche Reichsbahn. (5 700 Wörter & Abb.)

Zeitschrift des Vereines Deutscher Ingenieure. (Berlin.)

1935 **385 (.43)**
Zeitsch. des Ver. deutsch. Ing. Nr. 13, 30. März, S. 404.
WITTE (Fr.). — Die **Deutsche Reichsbahn** im Jahre 1934. (2 700 Wörter.)

1935 **625 .4 (.43)**
Zeitsch. des Ver. deutsch. Ing. Nr. 13, 30. März, S. 407.
GRABSKI (M.). — Vom Bau der **Berliner Nordsüd-S-Bahn.** (2 900 Wörter & Abb.)

1935 **621 .116**
Zeitsch. des Ver, deutsch. Ing. Nr. 14, 6. April, S. 429.
STODOLA (A.). — Leistungs- und Regelversuche an einem **Velox-Dampferzeuger.** (5 400 Wörter, 9 Tafeln & Abb.)

1935 **669**
Zeitsch. des Ver. deutsch. Ing. Nr. 14, 6. April, S. 437.
KALLEN (H.) & GEBHARD (K.). — Härtung der **Werkzeugstähle.** (3 700 Wörter & Abb.)

1935 **62. (01 & 669**
Zeitsch. des Ver. deutsch. Ing. Nr. 15, 13. April, S. 453.
RUDORFF (D. W.). — Die **Dauerstandfestigkeit** metallischer Werkstoffe und ihre Anwendung durch den Konstrukteur. (4 900 Wörter, 1 Tafeln & Abb.)

1935 **621 .116**
Zeitsch. des Ver. deutsch. Ing. Nr. 15, 13. April, S. 463.
ULRICH (M.). — **Nietlose Kesseltrommeln.** (3 600 Wörter & Abb.)

1935 **62. (01**
Zeitsch. des Ver. deutsch. Ing., Nr. 16, 20. April, S. 477.
BERTHOLD (R.). — Stand und Entwicklung der zerstörungsfreien **Werkstoffprüfung.** (5 700 Wörter & Abb.)

1935 **665 .882**
Zeitsch. des Ver. deutsch. Ing., Nr. 16, 20. April, S. 495.
HAARICH (S.). — Zur Frage der **Aluminiumschweissung.** (2 400 Wörter & Abb.)

Zeitschrift für das gesamte Eisenbahn-Sicherungswesen. (Berlin.)

1935 **656 .256 (.492)**

Zeitschrift für das gesamte Eisenbahn-Sicherungswesen, Nr. 5. 10. April, S. 51.

van AALDEREN (J.). — Die Niederländische Lösung der **Fernbedienung des Streckenblockwerks.** (900 Wörter & Abb.)

1935 **625 .162 (.43)**

Zeitschrift für das gesamte Eisenbahn-Sicherungswesen, Nr. 5, 10. April, S. 55.

BUDDENBERG. — Die **Reichsbahnschranke.** (2 300 Wörter, 6 Tafeln & Abb.)

Zeitung des Vereins Mitteleuropäischer Eisenbahnverwaltungen. (Berlin.)

1935 **385. (09.3 (.497.1 + .497.2)**

Zeitung des Vereins mitteleurop. Eisenbahnverwalt., Nr. 14, 4. April, S. 277.

REMY. — Fünfzig Jahre **Eisenbahngeschichte** und fünfzehn Jahre Nachkriegsentwicklung der südslawischen und bulgarischen Eisenbahnen. (3 900 Wörter.)

1935 **656 (.73)**

Zeitung des Vereins mitteleurop. Eisenbahnverwalt., 4. April, S. 282.

Die **Eisenbahnen der Vereinigten Staaten** von Amerika im Kampf. (1 000 Wörter.)

1935 **621 .137.2**

Zeitung des Vereins mitteleurop. Eisenbahnverwalt., Nr. 15, 11. April, S. 297.

WISKOTT. — **Zur Doppelführung** von Reisezügen des Fernverkehrs. (2 000 Wörter.)

1935 **656 .28**

Zeitung des Vereins mitteleurop. Eisenbahnverwalt., Nr. 17, 25. April, S. 342.

MARTENS (A.). — Ein Beitrag zur **Psychologie der Unfallverhütung.** (5 600 Wörter.)

In English.

Engineer. (London.)

1935 **627 (.44) & 656 .213 (.44)**

Engineer, No. 4132, March 22, p. 294.

New harbour works at Dunkirk. (3 300 words, tables & fig.)

1935 **62 (064 (.43)**

Engineer, No. 4132, March 22, p. 298.

Leipzig Technical Fair. — No. III. (1 800 words & fig.)

1935 **621 .13 (0 (.43) & 621 .132.3 (.43**

Engineer, No. 4132, March 22, p. 302.

High-speed streamlined locomotive. (400 words fig.)

1935 **621 .13 (0 & 656 .222.**

Engineer, No. 4132, March 22, p. 305.

On streamlining. (1 200 words.)

1935 **669 (06 (.42**

Engineer, No. 4132, March 22, p. 306.

Institute of Metals. — The penetration of steel b soft solder. — Type metal alloys. — Cadmium-ti alloys. — Tin containing aluminium, manganese, or bismuth. (4 100 words.)

1935 **621 .16**

Engineer, No. 4133, March 29, p. 320. — No. 413 April 5, p. 347. — No. 4135, April 12, p. 374.

The development of Parsons industrial turbo machinery. (9 800 words & fig.)

1935 **669 (06 (.42**

Engineer, No. 4133, March 29, p. 323.

Institute of Metals. — Hydrogen and stannic oxi in copper. Aluminium sand castings. — Alloys of magnesium. (5 900 words.)

1935 **62 (064 (.4**

Engineer, No. 4133, March 29, p. 325.

Leipzig Technical Fair. (1 800 words.)

1935 **621 .31 (.4**

Engineer, No. 4133, March 29, p. 334. — No. 413 April 5, p. 346.

Hydro-electric power plant at Cardano. (6 200 wor & fig.)

1935 **533 (.4**

Engineer, No. 4134, April 5, p. 351.

The twenty-four-foot **wind tunnel** at Farnboroug (4 000 words & fig.)

1935 **62. (01 & 621. (06 (.4**

Engineer, No. 4134, April 5, p. 354.

SCHUSTER (L. W.). — **The bend test, and i value as a guide to ductility.** (Abstract of a pap read at the Institution of Mechanical Engineers, Mar 26th, 1935.) (5 500 words & fig.)

1935 **62. (01 (.42) & 621 (06 (.4**

Engineer, No. 4134, April 5, p. 360.

Ductility and the bend test. (2 500 words.)

1935 **625 .142.2 & 6**

Engineer, No. 4134, April 5, p. 368.

Arsenic as a wood preservative. (700 words & fi

1935 **621 .31**

Engineer, No. 4135, April 12, p. 377.

Automatic synchronising equipment. (3 000 words & fig.)

1935 **669 .1**

Engineer, No. 4135, April 12, p. 379.

Research into cast and malleable cast iron. (1 400 words.)

1935 **533 (.42)**

Engineer, No. 4135, April 12, p. 380.

The **twenty-four-foot wind tunnel** at Farnborough. (2 900 words & fig.)

Engineering. (London.)

1935 **621 .13 (0 (.42 + .43) & 621 .132.3 (.42 + .43)**

Engineering, No. 3610, March 22, p. 308.

Streamlined locomotives. (1 200 words & fig.)

1935 **669 (06 (.42)**

Engineering, No. 3610, March 22, p. 317.

The Institute of Metals. — Penetration of steel by soft solder. — Type-metal alloys. — Cadmium-tin alloys. — Tin containing aluminium, manganese and bismuth. — Stannic oxide in copper. (4 700 words.) (To be continued.)

1935 **656 .222.1 (.42)**

Engineering, No. 3610, March 22, p. 324.

High-speed trial run on the London & North-Eastern Railway. (1 200 words.)

1935 **62. (01**

Engineering, No. 3611, March 29, p. 325.

CLAYTON (D.). — **An apparatus for the measurement of roughness.** (2 000 words & fig.)

1935 **624 (.73)**

Engineering, No. 3611, March 29, p. 329.

The San Francisco-Oakland transbay **bridge.** (2 200 words & fig.)

1935 **621 .98**

Engineering, No. 3611, March 29, p. 331.

48-in. stroke draw-cut shaping machine. (800 words & fig.)

1935 **621 .83**

Engineering, No. 3611, March 29, p. 334.

The Whaley positive **infinitely-variable reduction gear.** (1 200 words & fig.)

1935 **385 (093 (.42)**

Engineering, No. 3611, March 29, p. 338.

Early British railways. (600 words.)

1935 **669 (06 (.42)**

Engineering, No. 3611, March 29, p. 342.

The Institute of Metals. — Unsoundness in aluminium castings. — **Wrought magnesium alloys.** — Spectrographic analysis of aluminium. (4 900 words.)

1935 **624 .2**

Engineering, No. 3611, March 29, p. 345.

Maximum bending moment and shearing force diagrams for moving loads. (700 words & fig.)

1935 **621 .18 (.73)**

Engineering, No. 3612, April 5, p. 351.

The Schenectady **mercury-steam power station.** (2 800 words & fig.) (To be continued.)

1935 **621 .392 & 721 .9**

Engineering, No. 3612, April 5, p. 355.

BONDY (O.) & GOTTFELDT (H.). — Tubular members in **weld-steel structures.** (1 800 words & fig.)

1935 **621 .43**

Engineering, N. 3612, April 5, p. 359.

Tests on a Paxman-Ricardo **high-speed oil engine.** (1 800 words, 1 table & fig.)

1935 **62. (01 (.42) & 621. (06 (.42)**

Engineering, No. 3612, April 5, p. 368.

SCHUSTER (L. W.). — **The bend test and its value as a guide to ductility.** Paper presented at the Institution of Mechanical Engineers, March 29, 1935. (Paper and discussion.) (7 000 words & fig.)

Engineering News-Record. (New York.)

1935 **624 .2**

Engineering News-Record, No. 11, March 14, p. 379.

MAUGH (L. C.). — A rapid and concise method of **analyzing rigid viaduct bents.** (800 words & fig.)

1935 **624 .63 (.73)**

Engineering News-Record, No. 11, March 14, p. 389.

HUNT (Th. D.). — Continuous **concrete girders** use steel hanger joints. (1 400 words & fig.)

1935 **721 .3 & 721 .9**

Engineering News-Record, No. 12, March 21, p. 410.

MOREELL (B.). — The place and function of **steel in concrete columns.** (2 600 words.)

1935 **385. (091 (.71) & 625 .1 (.71)**

Engineering News-Record, No. 12, March 21, p. 412.

STEVENS (J. F.). — An engineer's recollections. I. — **Through the plains with the Canadian Pacific Ry.** (2 400 words & fig.)

1935 **625 .176 (.94)**

Engineering News-Record, No. 12, March 21, p. 414.

Australian main-line railroads to be converted to standard gage. (600 words.)

1935 **624 .1 (.47)**

Engineering News-Record, No. 12, March 21, p. 418.

KIENIA (M. A.). — **Pneumatic-caisson practice** in Soviet Russia. (3 500 words & fig.)

1935 **625 .143.4 (.42)**

Engineering News-Record, No. 12, March 21, p. 422.

Two-bolt rail joints in England cut splice material 50 per cent.

Great Western Railway Magazine. (London.)

1935 **656 .234 (.42)**

Great Western Ry. Magazine, April, p. 185.

Success of the holiday season tickets. — Some interesting facts about **season tickets** in general. (2 000 words & fig.)

1935 **625 .144.4 (.42)**

Great Western Ry. Magazine, April, p. 193.

Petrol-driven drills, saws and borers for permanent way work. (700 words & fig.)

1935 **625 .232 (.42)**

Great Western Ry. Magazine, April, p. 197.

G. W. Ry. **camp coaches** for the holidays. (900 words & fig.)

1935 **656 .225 (.42)**

Great Western Ry. Magazine, April, p. 201.

An innovation in G. W. Ry. « **station truck** » arrangements. (1 300 words & fig.)

1935 **625 .14 (.42) & 625 .15 (.42)**

Great Western Ry. Magazine, April, p. 209.

BOWLER (F. T.). — Great Western Ry. permanent way practice. — No. VIII. — The design and manufacture of **track components.** (800 words & fig.)

Journal, Institution of Engineers, Australia. (Sydney, N. S. W.)

1935 **38 & 656**

Journal, Institut. of Eng., Australia, February, p. 41.

REMFRY (M. A.). — Some economic **aspects of transport.** (11 000 words, tables & fig.)

1935 **62 (01 & 621 .392**

Journal, Institut. of Eng., Australia, February, p. 61.

BLACKWOOD (R. R.). — The effect of **welding** variables on the physical properties of electric arc weld metals. (2 300 words.)

1935 **621 .138.5, 621 .392 & 625 .26**

Journal, Institut. of Eng., Australia, February, p. 64.

FEATONBY (W.). — Application of **metallic arc** welding to railway rolling stock. (5 300 words & fig.)

Journal, Institute of Transport. (London.)

1935 **656 .212.**

Journal, Institute of Transport, March, p. 185.

FALCONER (E.). — **Goods shed operations.** (Pape and Discussion.) (13 500 words.)

1935 **347 .76**

Journal, Institute of Transport, March, p. 202.

EMMETT (E.). — **The law of carriage.** (5 400 words.

1935 **385 .5**

Journal, Institute of Transport, April, p. 226.

CLIFF (J.). — **The methods of negotiation betwee transport undertakings, their employees, and the trad unions.** (11 000 words.)

1935 **656 .**

Journal, Institute of Transport, April, p. 239.

WITCOMB SMITH (A.). — **Psychology and the roa transport driver.** (5 200 words.)

Mechanical Engineering. (New York.)

1935 **62. (01 & 62**

Mechanical Engineering, March. p. 157.

EVERETT (F. L.). — **Stress analysis of failures i machine parts.** (2 200 words & fig.)

1935 **53**

Mechanical Engineering, March, p. 162.

OSBORNE (N. S.), STIMSON (H. F.) & GINNING (D. C.). — **Steam research** at the Bureau of standard (1 200 words & 1 table.)

1935 **53**

Mechanical Engineering, March, p. 164.

KEYES (F. G.), SMITH (L. B.) & GERRY (H. T. — The equation of state for **superheated steam** an some comments on derived quantities. (500 words fig.)

1935 **621 .16**

Mechanical Engineering, March, p. 165.

SODERBERG (C. R.). — Recent developments i **steam turbines.** (5 800 words & fig.)

Railway Age. (New York.)

1935 **385 .**

Railway Age, No. 9, March 2, p. 322.

BUDD (R.). — **The railway status and outlook.** (3 50 words.)

1935 **625 .143.**

Railway Age, No. 9, March 2, p. 325.

BRUNNER (J.). — **Normalizing process perfected fo rails.** — Offers promise of eliminating transvers fissures and other internal defects increases resistanc to batter. (2 800 words & fig.)

1935 621 .138

ilway Age, No. 9, March 2, p. 329.

TITUS (H. J.). — Factors affecting the cost of locotive repairs. — Statistical evaluation of miles ween shoppings, intensity of utilization, age and wer in relation to locomotive maintenance expense. 800 words & fig.)

1935 625 .111 (.73) & 625 .162 (.73)

ilway Age, No. 10, March 9, p. 352.

More money for grade separation. (3 700 words, able & fig.)

1935 625 .162 (.73) & 656 .259 (.73)

ilway Age, No. 10, March 9, p. 357.

Federal funds for highway crossing protection. (2 400 rds, 1 table & fig.)

1935 621 .132.8 (.73)

ilway Age, No. 10, March 9, p. 361.

P. & W. V. articulated locomotive replaces two Consoations. (1 200 words, 1 table & fig.)

1935 621 .43 (.73)

ilway Age, No. 10, March 9, p. 363.

FETTERS (A. H.). — Comments on the development the Union Pacific streamline trains. (2 400 words.)

1935 621 .43 (.73)

ilway Age, No. 11, March 16, p. 386.

Reduced costs feature Zephyr operation. (1 700 words fig.)

1935 625 .26 (.73)

ilway Age, No. 11, March 16, p. 389.

Freight car repairs in relation to age. (3 200 words 10 tables.)

1935 625 .1 (06 (.73)

ilway Age, No. 11, March 16, p. 394.

A. R. E. A. holds three-day convention. (30 000 words.)

1935 656 .25 (06 (.73)

ilway Age, No. 11, March 16, p. 416.

Signal section, A. A. R., convenes in Chicago. (9 000 rds.)

1935 621 .132.3 (.518) & 625 .232 (.518)

ilway Age, No. 12, March 23, p. 446.

Streamlined train « Asia » for South Manchuria Railv. (1 600 words & fig.)

1935 385 .2 (.73)

ilway Age, No. 12, March 23, p. 451.

Hearings on water carrier bill. (5 500 words.)

1935 625 .1 & 656 .222.1

ilway Age, No. 12, March 23, p. 455.

Insuring safety of high speed trains. — The beginning a new era, by Elmer T. Howson. — Signaling for higher train speeds, by W. F. Zane. — Zephyr high-speed brake tests, by Joseph C. McCune. (9 000 words.)

1935 656 .261 (.43)

Railway Age, No. 12, March 23, p. 462.

Freight cars on the highways. (900 words & fig.)

Railway Gazette. (London.)

1935 625 .26 (.42)

Railway Gazette, No. 12, March 22, p. 549.

Further developments at Horwich works, L. M. S. Ry. — I. Line system of machining and assembling standard wagon axleboxes. (2 800 words & fig.)

1935 656 .254 (.73)

Railway Gazette, No. 12, March 22, p. 552.

Continuous cab signalling. (2 000 words & fig.)

1935 621 .138 (.73)

Railway Gazette, No. 13, March 29, p. 593.

Cost of locomotive repairs in U. S. A. (900 words.)

1935 656 (.931)

Railway Gazette, No. 13, March 29, p. 600.

ARTHURTON (A. W.). — Impressions of overseas transport. — XV. A tour by rail, road and steamer in the South Island of New Zealand. (1 200 words.)

1935 656 .23 (.42) & 659 (.42)

Railway Gazette, No. 13, March 29, p. 601.

Realising the L. M. S. quota. (A scheme which turns the business of securing traffic into a competitive sport. (2 300 words & fig.)

1935 625 .26 (.42)

Railway Gazette, No. 13, March 29, p. 604.

Further developments at Horwich works, L. M. S. Ry. — II. Line system of machining and assembling standard wagon axleboxes. (1 400 words & fig.)

1935 62. (01 (.54) & 624 (.54)

Railway Gazette, No. 13, March 29, No. 607.

Recent practice in testing of bridges in India. (2 200 words & fig.)

1935 621 .132.6 (.438) & 625 .616 (.438)

Railway Gazette, No. 13, March 29, p. 612.

New Polish-built locomotives for Latvia. (1 000 words & fig.)

1935 621 .43 (.42) & 625 .175 (.42)

Railway Gazette, No. 13, March 29, p. 614.

New 38-seater motor gang trolley. (350 words & fig.)

1935 656 .222.1 (.42)

Railway Gazette, No. 14, April 5, p. 633.

Speeding up. (1 000 words.)

1935 **656 (.96)**

Railway Gazette, No. 14, April 5, p. 639.

ARTHURTON (A. W.). — **Impressions of overseas transport. — XVI. Up-to-date transport conditions prevail in the larger islands of the Pacific and those of the Hawaiian group are connected by daily steamer and air services.** (1 200 words.)

1935 **625 .1 (.945)**

Railway Gazette, No. 14, April 5, p. 640.

Permanent way in Victoria. (1 000 words, 1 table & fig.)

1935 **656 .254 (.42)**

Railway Gazette, No. 14, April 5, p. 642.

Train describer with printed record. (1 000 words & fig.)

1935 **621 .132.3 (.73)**

Railway Gazette, No. 14, April 5, p. 644.

American **high-speed streamlined steam locomotive.** (700 words & fig.)

1935 **621 .132.6 (.43)**

Railway Gazette, No. 14, April 5, p. 645.

New **high pressure 2-4-2 superheated tank locomotives.** (700 words & fig.)

1935 **621 .138.5 (.42)**

Railway Gazette, No. 14, April 5, p. 646.

Improvements at Doncaster works, L. N. E. Ry. (2 200 words & fig.)

1935 **621 .132.3 (.493)**

Railway Gazette, No. 14, April 5, p. 650.

New Belgian Pacific locomotives. (350 words & fig.)

1935 **625 .231 (.42)**

Railway Gazette, No. 14, April 5, p. 653.

Camping coaches on the British Railways. (900 words & fig.)

1935 **621 .335 (.44) & 621 .43 (.44)**

Diesel Ry. Traction, p. 575. Supplt. to Ry. Gazette, March 22.

Two **super-power Diesel-electric locomotives** for the P. L. M. (500 words & fig.)

1935 **656 .222.1 & 656 .25**

Diesel Ry. Traction, p. 575, Supplt. to Ry. Gazette, March 22.

High speeds and the signalling problem. (700 words.)

1935 **621 .335 (.492) & 621 .43 (.492)**

Diesel Ry. Traction, p. 576, Supplt. to Ry. Gazette, March 22.

Diesel traction on Dutch secondary railway. (350 words & fig.)

1935 **621 .43 (.45)**

Diesel Ry. Traction, p. 577, Supplt. to Ry. Gazette, March 22.

New Italian **high-speed oil-engined railcar.** (1 300 words & fig.)

1935 **621 .335 (.73) & 621 .43 (.7**

Diesel Ry. Traction, p. 580, Supplt. to Ry. Gazett March 22.

Another 100 m. p. h. train in North America (9 words & fig.)

1935 **621 .43 (.44) & 656 .222 (.4**

Diesel Ry. Traction, p. 582, Supplt. to Ry. Gazett March 22.

High speed Diesel services on the Nord. (800 wor & fig.)

1935 **621 .43 (.73) & 656 .222 (.7**

Diesel Ry. Traction, p. 584, Supplt. to Ry. Gazett March 22.

The Burlington Zephyr and its services. (1 000 word tables & fig.)

1935 **621 .335 (.493) & 621 .43 (.49**

Diesel Ry. Traction, p. 587, Supplt. to Ry. Gazett March 22.

Streamlined Diesel-electric trains for Belgium. (5 words, 1 table & fig.)

1935 **621 .33 (.49**

Electric Ry. Traction, p. 666, Supplt. to the Ry. Gazett April 5.

First Belgian main-line electric railway between Bru sels and Antwerp. (1 800 words & fig.)

1935 **621 .33 (.43) & 656 .259 (.4**

Electric Ry. Traction, p. 670, Supplt. to the Ry. Gazett April 5.

Special warning signs for electrified sections on th German State Railways. (600 words & fig.)

1935 **621 .335 (.4**

Electric Ry. Traction, p. 671, Supplt. to the Ry. Gazett April 5.

Italian-built electric locomotives for Russia. (4 words & fig.)

1935 **621 .33 (.4**

Electric Ry. Traction, p. 672, Supplt. to the Ry. Gazett April 5.

New **standard-gauge Italian electric railway.** (9 words & fig.)

1935 **621 .33 (.49**

Electric Ry. Traction, p. 674, Supplt. to the Ry. Gazett April 5.

BEAVER (S. H.). — **The Hellenic electric railwa** (1 000 words & a map.)

1935 **621 .33 (.82) & 625 .4 (.8**

Electric Ry. Traction, p. 675, Supplt. to the Ry. Gazett April 5.

Buenos Aires underground. (400 words & fig.)

1935 **621 .3**

Electric Ry. Traction, p. 676, Supplt. to the Ry. Gazett April 5.

New electric locomotive drive. (British Thomson Houston.) (450 words & fig.)

Railway Magazine. (London.)

1935 **621 .43 (.42)**

ilway Magazine, April, p. 235.

REED (B.). — **Diesel traction on the L. M. S. Ry.** 000 words, 1 table & fig.)

1935 **656 .222.1 (.42)**

ilway Magazine, April, p. 239.

ALLEN (C. J.). — **The L. N. E. Ry. world records. —** 8 m. p. h. maximum and 300 miles at 80 m. p. h. 700 words & fig.)

1935 **656 .222.1 (.42)**

ilway Magazine, April, p. 244.

ALLEN (C. J.). — **British locomotive practice and rformance.** (2 400 words, tables & fig.)

1935 **725 .31 (.42)**

ailway Magazine, April, p. 265.

COOPER (B. K.). — **The design of stations.** (1 200 ords & fig.)

Railway Mechanical Engineer. (Ph adelphia.)

1935 **621 .335 (.73) & 621 .43 (.73)**

ailway Mechanical Engineer, March, p. 85.

The second **self-propelled stainless steel train.** (5 500 ords & fig.)

1935 **62. (01, 621 .134.1 & 669**

ailway Mechanical Engineer, March, p. 93.

TEMPLIN (R. L.). — Stress distribution in alumi-um **connecting rods.** (3 000 words, 4 tables & fig.)

1935 **621 .132.8 (.73)**

ailway Mechanical Engineer, March, p. 97.

Articulated locomotives for Pittsburg and West Vir-inia. (1 600 words, tables & fig.)

1935 **621 .43 (.73) & 625 .2 (0 (.73)**

ailway Mechanical Engineer, March, p. 101.

FETTERS (A. H.). — **Sidelights** on the Union Paci-c **streamline trains.** (3 300 words.)

1935 **625 .252**

ailway Mechanical Engineer, March, p. 103.

High-power hand brake. (800 words & fig.)

1935 **625 .26 (.73)**

ailway Mechanical Engineer, March, p. 108.

Freight-car reconditioning on the Illinois Central. 2 800 words & fig.)

1935 **625 .233 & 625 .234**

ailway Mechanical Engineer, March, p. 113.

Medart compensating car axle drive. (900 words fig.)

1935 **625 .25 (.73) & 625 .26 (.73)**

ailway Mechanical Engineer, March, p. 115.

Pennsylvania **air brake shop** at Pitcairn, Pa. (1 100 ords & fig.)

Railway Signaling. (Chicago.)

1935 **625 .162 (.73) & 656 .259 (.73)**

Railway Signaling, March, p. 127.

Highway crossing signals on the Seabord in Carolina. (1 900 words & fig.)

1935 **625 .162 (.73) & 656 .259 (.73)**

Railway Signaling, March, p. 129.

Crossing signals on the A. C. L. in Florida. (1 900 words & fig.)

1935 **656 .256.2 (.73) & 656 .256.3 (.73)**

Railway Signaling, March, p. 135.

LINN (F. A.). — **Low-voltage capacitors** for power-factor correction. (3 400 words & fig.)

1935 **656 .25 (06 (.73)**

Railway Signaling, March, p. 139.

Signal Section (A. A. R.) convenes in Chicago. (16 000 words.)

1935 **621 .43 (.73) & 656 .254 (.73)**

Railway Signaling, March, p. 150.

Cab signals and A. T. C. on Union Pacific streamliner. (600 words & fig.)

Proceedings, American Society of Civil Engineers. (New York.)

1935 **62. (01, 669 .1 & 721 .9**

Proceed., Amer. Soc. of Civil Eng., January, p. 3.

RATHBUN (J. Ch.). — **Elastic properties of riveted connections.** (8 200 words & fig.)

1935 **627 .82**

Proceed., Amer. Soc. of Civil Eng., January, p. 43.

CRAVITZ (Ph.). — Analyses of thick arch **dams** including abutment yield. (3 000 words & fig.)

1935 **624 .51**

Proceed., Amer. Soc. of Civil Eng., January, p. 93.

A generalized deflection theory for **suspension brid-ges**, by D. B. STEINMAN, paper published in March 1934. Proceedings. — Discussion by W. R. FREDERICK, Jr. & W. H. YATES. (3 000 words, tables & fig.)

1935 **627 .82 & 693**

Proceed., Amer. Soc. of Civil Eng., February, p. 187.

COLE (D. W.). — **Stabilizing constructed masonry dams by means of cement injections.** (14 500 words, tables & fig.)

1935 **721 .9**

Proceed., Amer. Soc. of Civil Eng., February, p. 225.

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1935 **62. (01**

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1935 **693 & 721 .9**

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Masonry and reinforced concrete. — Progress report of Committee of the structural division. (2 800 words.)

1935 **721 .1**

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Proceedings, Institution of Mechanical Engineers. (London.)

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BAKER (H. W.). — **The operating temperatures of cast iron and aluminium pistons in a 12-inch bore oil engine.** (10 000 words, tables & fig.)

1934 **62. (01, 621 .134.1, 621 .135.2 & 669 .1**

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1934 **669 .1 (06 (.42)**

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1934 **62. (01 & 669 .1**

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1934 **621 .116**

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1934 **626 .131.4**

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1934 **621 .125**

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Wagons for the conveyance of grain in bulk, Gre Southern Rys. (300 words & fig.)

Transactions, American Society of Mechanical Engineers. (New York.)

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ournal of Applied Mechanics, p. A-1, March, Amer. Soc. of Mech. Engineers.

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oletín de la Asociación Gen. de transp. por vía férrea, suplemento de febrero, p. 44.

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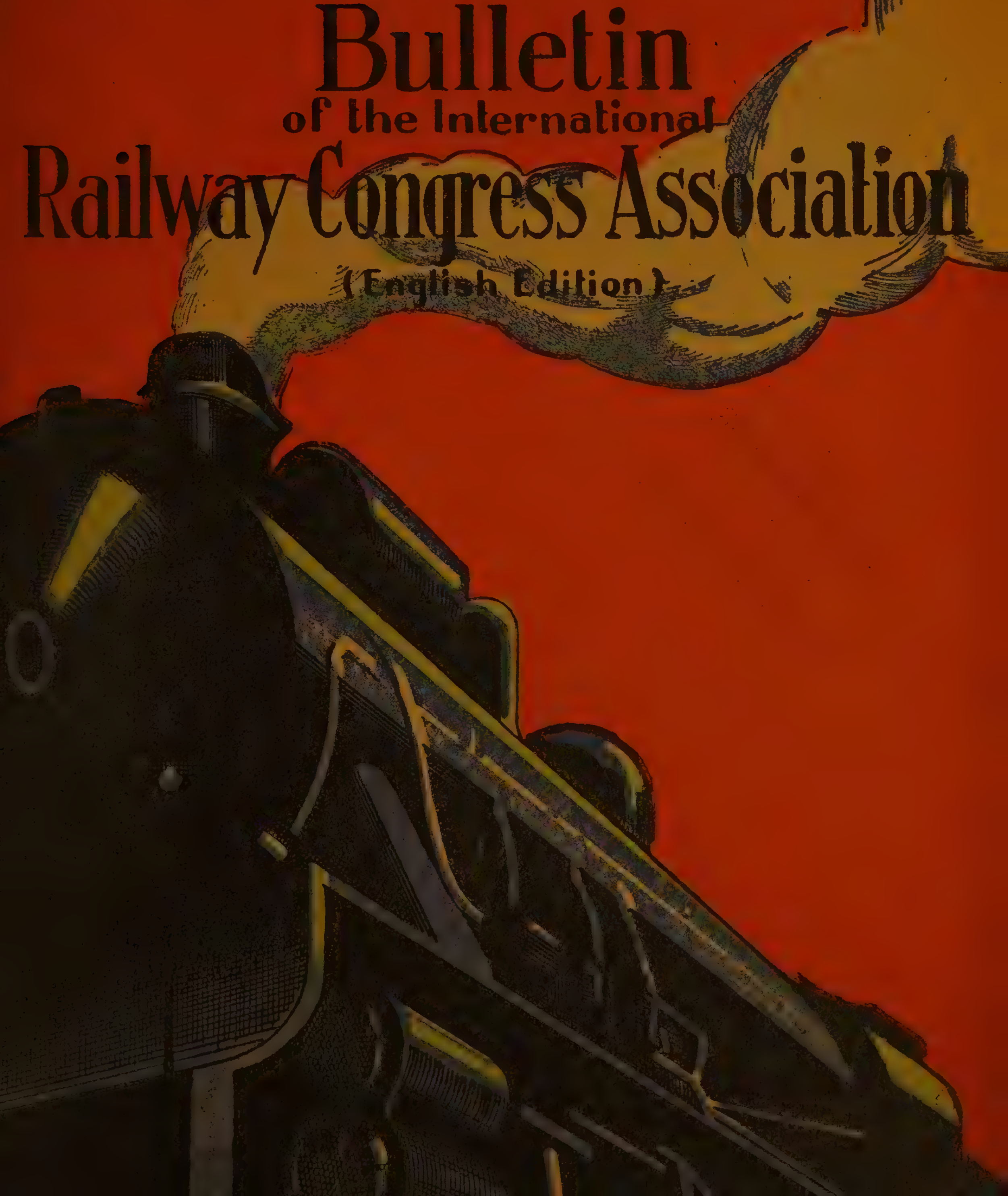

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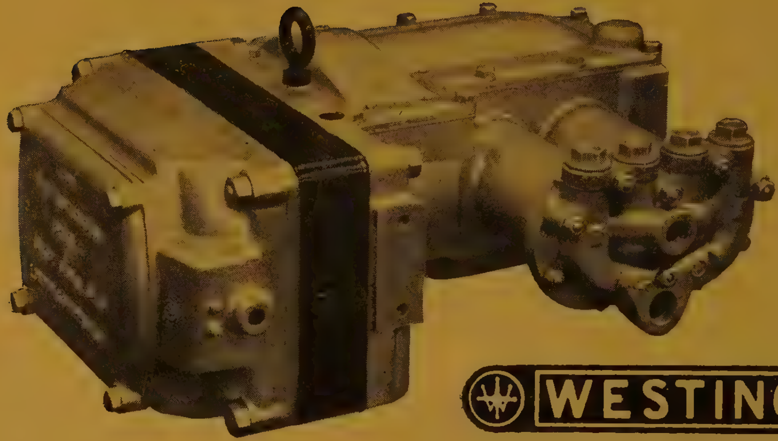

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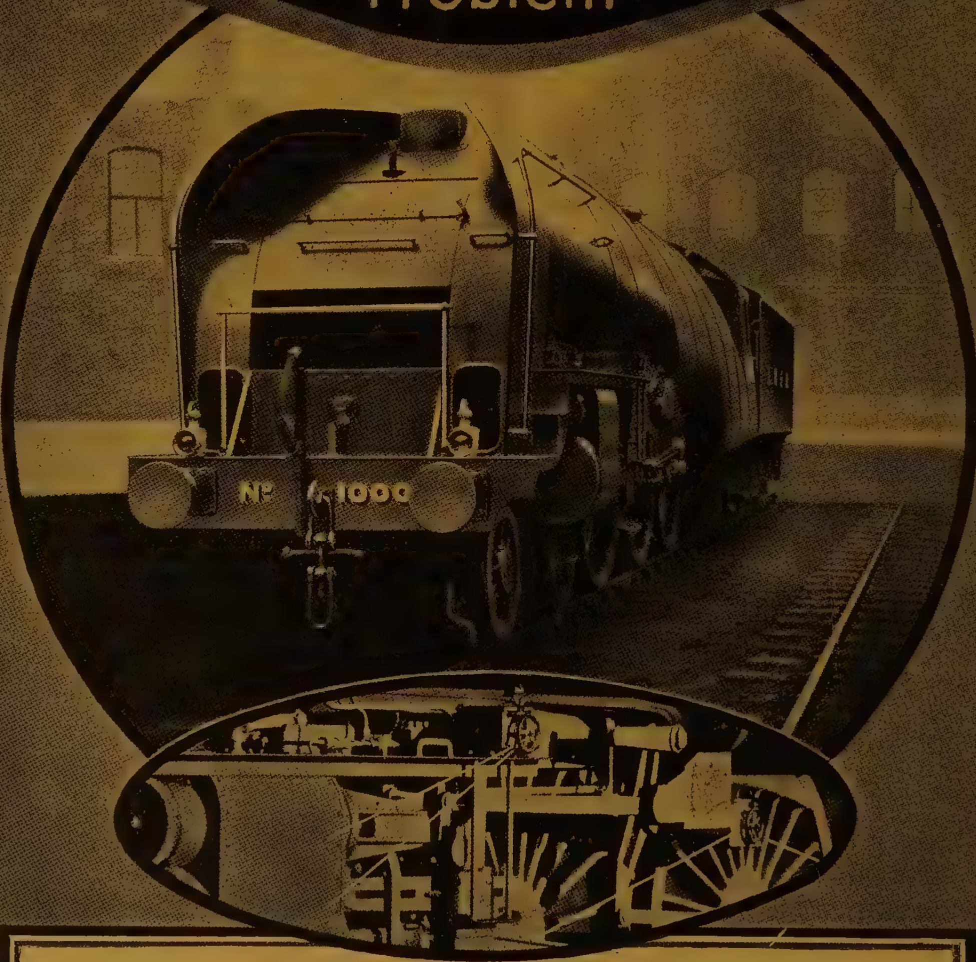

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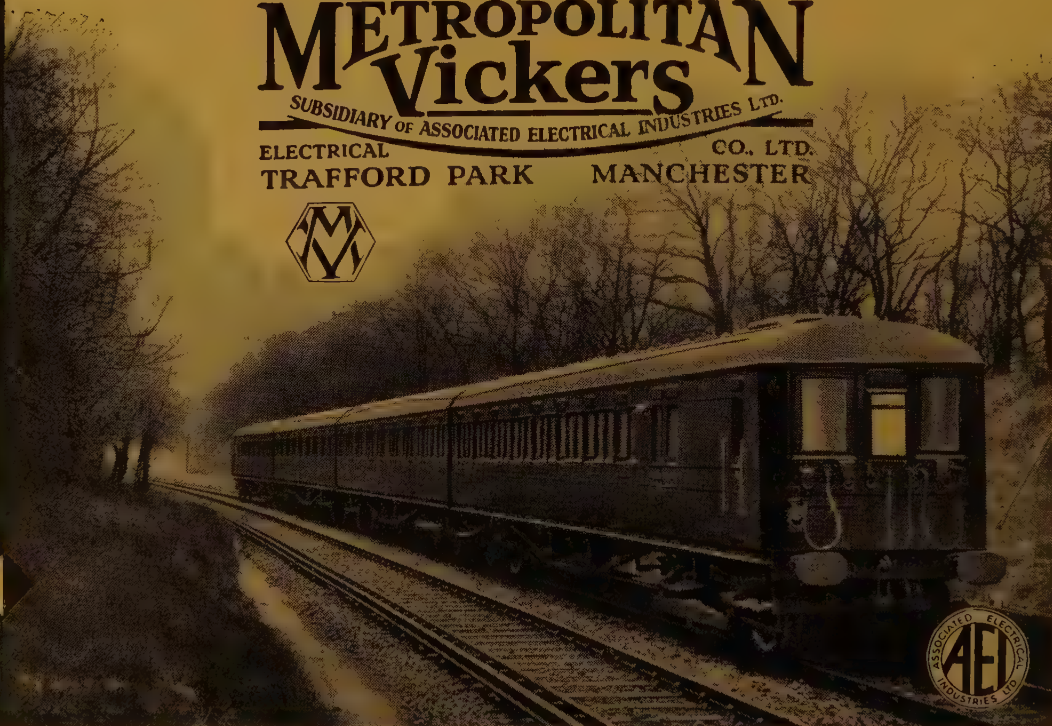

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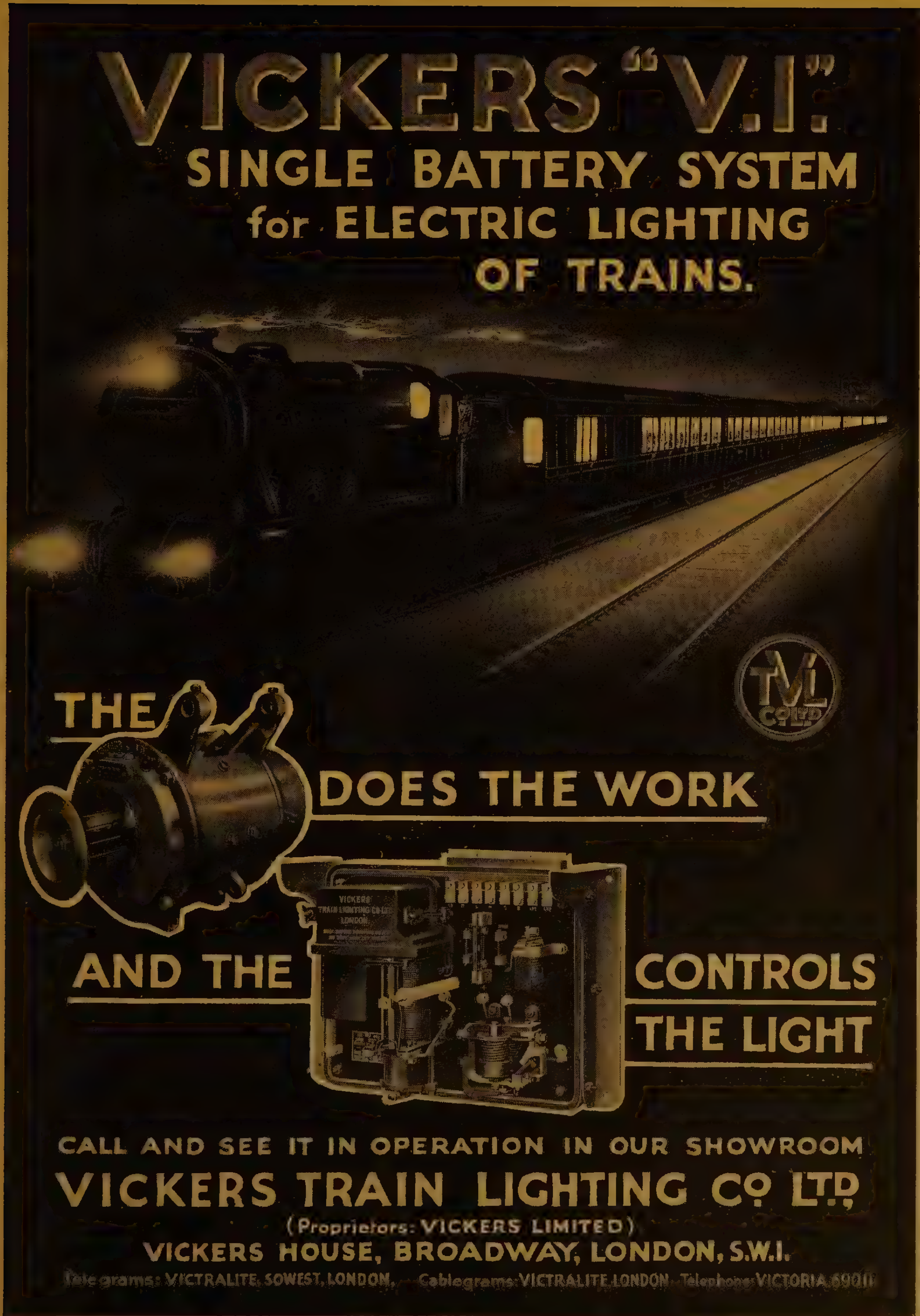
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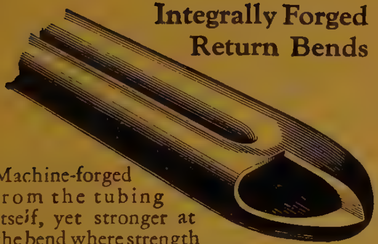
United Steel Companies, Ltd. (The) . .	X	Steel sleepers, steel for all purposes.
Vacuum Brake Co., Ltd.	XXVI	Air brakes.
Vacuum Oil Company, Ltd.	—	Lubricants for locomotives.
Vereinigte Eisenbahn-Signalwerke . . .	IV	Railway signalling.
Vereinigte Westdeutsche Waggonfabriken	—	Rolling stock.
Vickers Train Lighting Co., Ltd. . . .	XIV	Train lighting dynamos and equipment.
Vi-Spring Products, Ltd.	—	Seat springs.
Wakefield & Co,, Ltd.	V	Mechanical lubricators: oils for all purposes.
Ward & Ltd.	XXII	Machine Tools.
Westinghouse Brake & Signal Co., Ltd.	I, II, III	Railway signalling. Brakes. Heating systems.
Wild & Co. (A. G.)	—	Railway supplies, steam heating, etc.
Willford and Company, Ltd.	XXIII	Railway springs and for all their purposes.

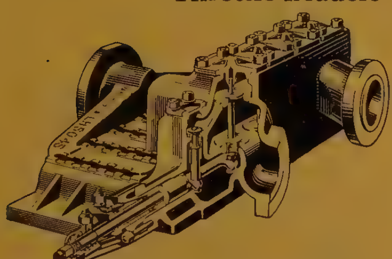
Serving the Superheating Requirements *of the* World's Railways

Integrally Forged Return Bends



Machine-forged from the tubing itself, yet stronger at the bend where strength is most needed. Provides constant area through the bend, with smooth internal and external surfaces—avoiding restriction of steam through units or accumulation of soot, ashes or cinders.

Multiple-valve Throttle-headers



A finger-type header with multiple-valve throttle or regulator contained in the casting. Without changing smokebox arrangement this throttle-header offers distinct advantages: Steam is controlled between the superheater and cylinders; superheated steam is always available for auxiliaries; use of a series of small valves opening and closing consecutively gives better and quicker control of locomotive movements.

Through a coordinated service with associated organizations in Great Britain, France, Germany, the United States, Canada, and Australia, the railways of the world are served with locomotive superheating equipment, that conforms to a general standard of practice, yet is adapted to the particular requirements of each individual country.

A distinguishing characteristic of the locomotive superheaters manufactured by these associated companies is the exclusive use of return bends, integrally forged with the tubing to form the loops of the superheater elements or units. These bends are machine-forged without utilizing either additional material or a flux. Railroads the world over have standardized on locomotive superheaters with these integrally-forged return bends. They have been applied to more than 100,000 locomotives.

These associated companies, as a result of constant development and research, and interchange of combined experience in modern railroading, offer improved superheating equipment to meet the changing conditions of locomotive operation. An outstanding recent development, now being adopted rapidly for every class of locomotive service, is the multiple-valve throttle-header.

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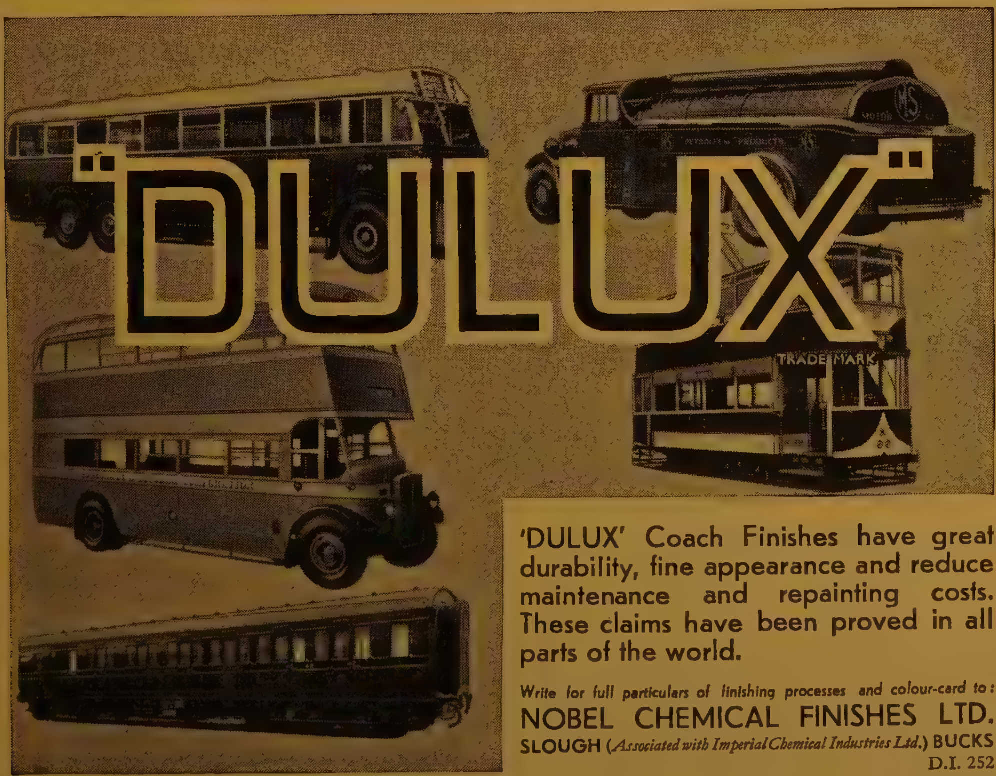
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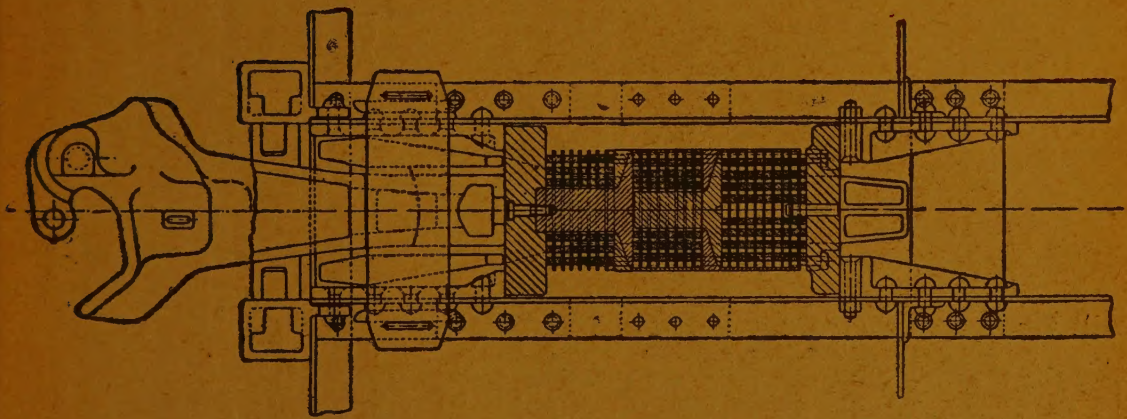

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